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Review of the Genus Polycheria Haswell, A Symbiotic Group of Amphipods (Crustacea: Dexaminidae) with Descriptions of New Species from Florida, the Caribbean Sea, and the Indo-Pacific Region

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The University of Southern Mississippi

REVIEW OF THE GENUS *POLYCHERIA* HASWELL, A SYMBIOTIC GROUP OF AMPHIPODS (CRUSTACEA: DEXAMINIDAE) WITH DESCRIPTIONS OF NEW SPECIES FROM FLORIDA, THE CARIBBEAN SEA, AND THE INDO-PACIFIC REGION

by

John Milton Foster

A Dissertation
Submitted to the Graduate Studies Office
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

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ABSTRACT

REVIEW OF THE GENUS *POLYCHERIA* HASWELL, A SYMBIOTIC GROUP OF AMPHIPODS (CRUSTACEA: DEXAMINIDAE) WITH DESCRIPTIONS OF NEW SPECIES FROM FLORIDA, THE CARIBBEAN SEA, AND THE INDO-PACIFIC REGION

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Systematics and taxonomy of the dexaminid amphipod genus *Polycheria* Haswell (Dexamindae: Amphipoda), whose members are cosmopolitan associates of tunicates and sponges, are confused. This is due in large part to the many inadequate and incomplete descriptions and poorly some executed illustrations, especially for the early studies on the group. Previously, 22 nominal species or forms have been described or designated in the literature. The purpose of this study is to critically review and clarify the systematics of this enigmatic genus. Based on personal collections and on specimens from museums, five new species are designated and 22 species or forms are re-described. All the species and forms of *Polycheria* are illustrated and a dichotomous key constructed for their identification. For cladistic analysis, a suite of 77 morphological characters were selected and coded in DELTA. Analysis was preformed using PAUP, including strict consensus, 50% majority rule, and decay indices. The resulting best tree indicated that *Polycheria* is a monophyletic group characterized by (1) subchelate pereopods 3-7; (2) absence of palp on maxilla on the mandibles; (3) lower lip inner and outer lobes well developed; (4) a one-articulate palp on maxilla 1, and (5) and a 4-articulate palp on the maxilliped.

The hypotheses presented, based on the currently understood

distribution of *Polycheria,* the current and historical position of the continents and major oceanic currents, and the majority rule consensus tree generated from 77 parsimonious characters, indicates that (1) *Polycheria* had its origins in the Southern Ocean between Antarctica and the Australia/New Zealand area; (2) the dispersal of the ancestral *Polycheria* genotype occurred along at least two tracks – a circumpolar track eastward around Antarctica, driven by the Antarctic Circumpolar Current and along a northern track around New Zealand, along the east coast of Australia, into the Australasian region, and eventually northward to the Sea of Japan; and (3) the Antarctica peninsula appears to be an area of high speciation from which dispersals eastward into the Indian Ocean and possibly Australia originated.

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CHAPTER I

PROBLEM AND BACKGROUND

Introduction

Over twenty nominal species or forms attributable to the dexaminid amphipod genus *Polycheria* Haswell, 1879 have been reported from coastal marine waters of Africa, Antarctica, East Asia, North America, South America, Australia, New Zealand, Indonesia, Indian Ocean, and the Southern Ocean (Barnard and Karaman, 1991; Debroyer and Jazdzewski, 1993; Bousfield and Kendall, 1994). The only published records for *Polycheria* in the North Atlantic Ocean and the Arctic Ocean were summarized by LeCroy, 2004. The type species, *Polycheria tenuipes,* was originally described from Port Jackson Australia, by Haswell, 1879.

Species of *Polycheria* are known to create and occupy cavities on the surface of compound ascidians and sponges (Skogsberg and Vansell, 1928, Arndt, 1933, Lambert, 1979). However, the sponge-ascidian substrata are not exclusive. There are reports of *Polycheria* living among algae, stones, and gravel (Schellenberg, 1931), and there are two reports of it occurring on a gorgonian (Debroyer et al., 2001; LeCroy, 2004). The exact nature of these relationships, such as structural adaptations, between the hosts and the host selecting symbiont amphipod requires more research. Available information about the host selection and feeding behavior of *Polycheria,* drawn from the literature, field observations, and notes from museum collections indicate that it is symbiotic primarily with sponges and ascidians. There is no firm consensus supported by data regarding the nature of those relationships, particularly as to whether the interactions are commensal, as defined in classical terms (Dauby, et al. 2001; Schmidt et al., 1995), or ectoparasitic, including the consumption the host's biomass (Skogsberg and Vansell, 1928; Kunzmann, 1996). Table 1 presents a summary by geographic region for reports of *Polycheria* in the taxonomic and ecological literature (1875- 2008) and Figure 1 depicts the type localities of the species and forms.

Table 1 – Reports for the geographic distribution of *Polycheria* in the taxonomic and ecological literature for 1875-2008

	Arndt, 1933; Barnard, K.H, 1916; 1940;1955; Bellan-Santini, 1972; 1974; Gappa et al., 2006; Griffiths 1973; 1974;a; 1974b; 1974c; 1975; 1976; Ledoyer, 1972; 1982; Pillai, 1957; Schellenberg, 1931; Walker, 1904; 1905; 1909
Australia and New Zealand	Barnard, 1972; Brewin, 1946; Chilton, 1821; HLW, 1929; Haswell, 1879; Lowry and Bullock, 1976; Stoddart and Lowry, 2003; Thomson, 1882; Thomson and Chilton, 1885
Antarctica and the Southern Ocean	Arndt, 1933; Arntz and Gutt, 2007; Barnard, 1992; Barnard, K.H., 1916; 1932; 1937; Cherel et al., 2002a; 2002b; Chiesa and Alonso, 2006; Chilton, 1912; Dauby et al., 2001; Debroyer and Jazdzewski, 1993; Debroyer and Rauschert, 1999; Debroyer et al, 2001; 2007; Holman and Watling, 1983; Kawaguchi et al, 1996; Kunzmann, 1996; Lorz, 2001; Lowry and Bullock, 1976; Lowry, 1981; Schellenberg, 1925; 1926; 1931; Stebbing, 1875; 1888; 1906;

	1910; Stephenson, 1947; Thurston, 1974a; 1974b; Voss, 1998; Wakabara et al., 1990; 1995; Walker, 1907
Eastern Pacific Ocean	Alderman, 1936; Barnard, 1954; 1969a; 1969b; 1969c; 1970; 1975; 1979; 1991; Bousfield and Kendall, 1994; Calman, 1898; Hewatt, 1937; Lambert, 1979; MacGinitie and MacGinitie, 1968; Ricketts et al., 1968; Skogsberg and Vansell, 1928; Setran et al., 1993; Staude, 1987; Vader, 1969
Northwest Pacific Ocean	Bulycheva, 1952; Hirayama, 1984; Ishimaru, 1994; Nagata, 1964
Indo-West Pacific Ocean	Barnard, 1976
South America and Southwest Atlantic Ocean	Gonzales, 1991; Schellenberg, 1931; Chiesa and Alonso, 2007
Northwest Atlantic Ocean	Camp et al., 1998; LeCroy, 2004; Mason and Zengal, 1996; Mason et al., 1994; McKinney, 1977; Ortiz, 1979; Shoemaker, 1935
Mediterranean Sea	Bellan-Santini, 1982; Costello et al., 2001; Della Valle, 1893; Ruffo and Krapp, 2005; Rutzler, 1976;

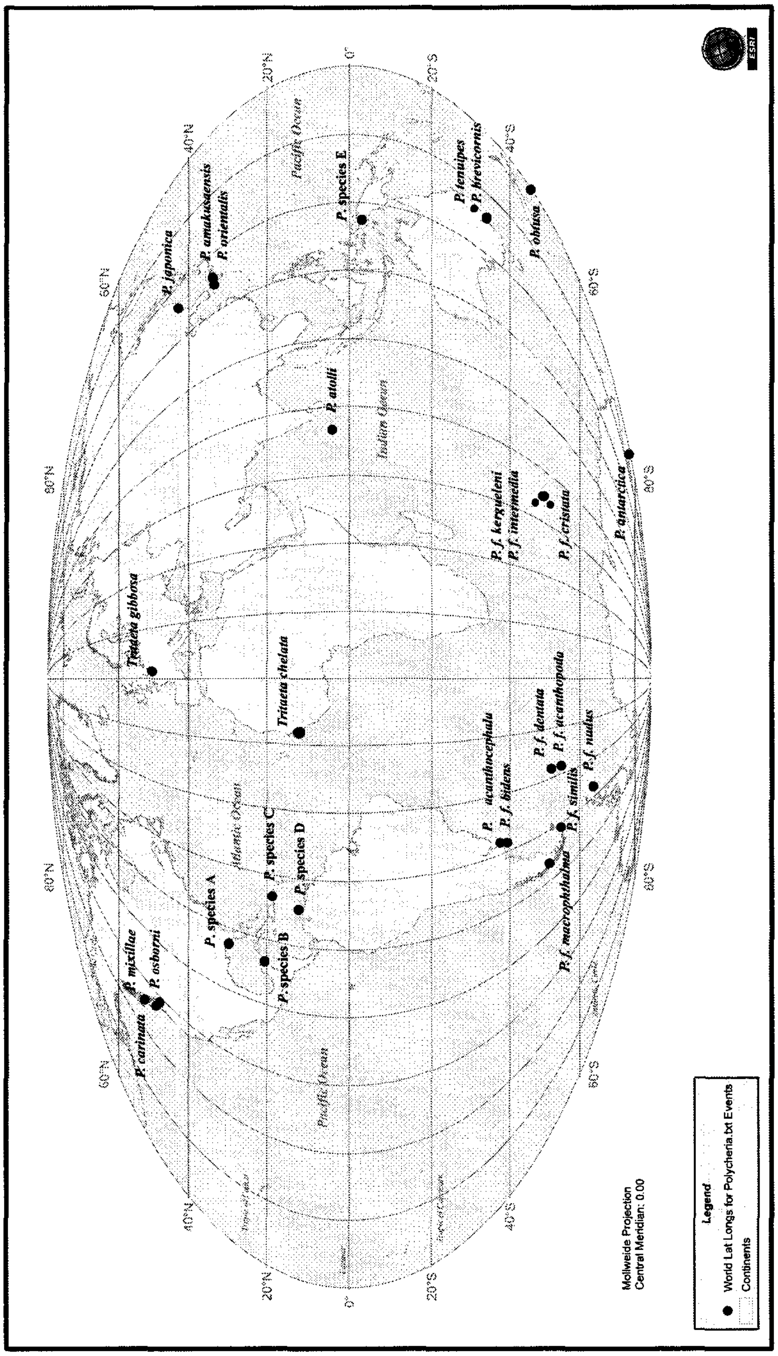

Figure 1 – Map depicting the overall distribution and type localities of the species and forms of *Polycheria*, including the new species described herein, and the related genus *Tritaeta* (Dexaminidae)

Objectives of Study

A taxonomic revision is necessary to redefine the genus *Polycheria* to (1) establish a neotype for the generotype *P. tenuipes* Haswell, 1879 (see Stoddart and Lowry, 2003; Lowry and Bullock, 1976); (2) when possible develop clear and consistent diagnoses for all previously described species; (3) re-describe, select, and deposit specimens for the "formae," if considered distinct species, and (4) describe new species found in museum collections or from subsequent fieldwork. Much that work is beyond the scope of this project. However, the problem to which the report is addressed was well summarized by Thurston (1974b: 90) "Since *Polycheria antarctica* was described by Stebbing (1875) [as *Dexamine antarctica*], specimens from many localities have been ascribed to this species and a considerable number of forms and varieties has been attributed to it. It is difficult to at present to access the importance of the variation within *P. antarctica* as currently understood; a fact which emphasizes the need for more critical observations of new and old material."

The objectives of my research are (1) the preparation of the descriptions and illustrations of new species of *Polycheria* symbiotic with compound ascidians and sponges from the inshore waters of Florida and the Caribbean Sea and Papua New Guinea and the presentation of re-diagnoses and selected illustrations of all known species and forms of *Polycheria,* from museum specimens or literature accounts.

(2) Coding (in DELTA, Dallwitz, 1980) of morphological characters and character states derived from the examination of *Polycheria* material collected in the Gulf of Mexico and Caribbean Sea, borrowed from institutions abroad, or described in the literature. Using cladistic methods, several hypotheses for the phylogeny of *Polycheria*

will are tested using maximum likelihood trees developed in PAUP® using maximum parsimony analysis (see Chapter 3 for detailed cladistic methodology).

(3) Because no previous cladistic analyses have been applied to the genus *Polycheria,* the results of the analysis are used as a point of comparison with the taxonomic arrangement of the genus *Polycheria,* as set forth in the key of Thurston (1974b) and the phenogram of Bousfield and Kendall (1994), which represent the only existing taxonomic analyses of the genus, and the basis for current hypothesis on the phylogeny of the genus.

(4) A biogeographic review of the distribution of *Polycheria* based upon comparative morphology (i.e., observing for characters and character states that might be reliably associated with a specific geographical region). This information will be utilized to test the hypothesis of Bousfield and Kendall (1994) that Southern Ocean species are pleisomorphic and that species occurring in the North Pacific and Western Atlantic Oceans differ from them significantly by their shared derived characters. Pleisomorphic characters are understood to be basal characters found in all species of *Polycheria.* A character matrix of gradation between pleisomorphic and apomorphic characters was developed for all species and form and based on the one applied to North Pacific *Polycheria* species by Bousfield and Kendall (1994). In addition, detailed comparisons are made of the morphological characters of the dexaminid genera *Polycheria* and *Tritaeta,* which are morphologically and ecologically similar. For the outgroup analysis, *Dexamine spinosa* (Montagu, 1813) will be used.

(5) To determine if any *Polycheria* species described in this report from Florida and the Caribbean Sea demonstrates obvious host-specific behavior with ascidians and sponges.

(6) To determine, based on field and laboratory observations, what extent the behavior of *Polycheria* sp. A varies from that described for other species, specifically *Polycheria osborni* (Calman, 1898), as observed in detail by Skogsberg and Vansell (1928).

(7) A review history of the species of *Polycheria* in the literature, a tabulation of information on the host species, maps the geographical distribution of all species and forms, and graphic displays bathyal and spatial distribution of the genus as reported in the literature and field observations.

Significance of the Study

Although the genus *Polycheria* has not received much attention from either taxonomists and ecologists during the past century, it may like, the genus *Leucothoe sensu strito* (Thomas & Klebba 2006, per. comm. 2008), another genus of commensal amphipods, prove to represent a large complex of cryptic species, especially when subjected to stringent comparative studies of its members morphology in conjunction with host specificity. Preliminary research results on host preferences of numerous species of the *Leucothoe* in various ascidians and sponges in Florida, the Caribbean Sea, and the Indo-Pacific region, indicate a much greater degree of speciation and geographical variation than had been previously understood.

For the Northwest Atlantic region, the results of my research will clarify the taxonomy of the genus in an area of the world from which no species were previously known. Previous reports of *Polycheria* species have generally provided few illustrations; this report will present original illustrations of characters not previously published and reproductions of some previously published illustrations.

CHAPTER II

HISTORICAL REVIEW

The Family Dexaminidae

The family Dexaminidae Leach, 1813/14 is nearly cosmopolitan. It consists of 18 genera and was divided by Barnard and Karaman (1991) into two subfamilies, based on the shape of pereopods 5-7 and the degree of enlargement of the fifth coxal plate. Dexaminids are recognized by the combination of the following characters: a basic amphipod head; body laterally compressed; at least 2 urosomites coalesced (2-3 in *Polycheria*); coxae rounded to acuminate; eyes, if present, ommatidial; accessory flagellum, if present, 1-2 segmented, vestigial; gnathopods 1-2 subchelate, medium enfeeblement; pereopods 3-4 not glandular; pereopod 7, less than 1.2 X pereopod 6, occasionally a different form from pereopods 5-6; uropod 3 biramous; telson laminar, more/less cleft (Barnard and Karaman, 1991).

Two subfamilies are recognized by Barnard and Karaman, 1991: Dexamininae (consisting of *Delkalye* Barnard, 1972, *Dexaminella* Schellenberg, 1928, *Dexamine* Leach 1813/1814 , *Tritaeta* Boeck, 1876, *Polycheria* Haswell, 1879, *Lepechinelloides* Thurston, 1980, *Paradexamine* Stebbing, 1899, *Syndexamine* Chilton, 1914, *Atylus* Leach, 1815, *Sebadexius* Ledoyer, 1984, *Lepechinellopsis* Ledoyer, 1982, *Lepechinella* Stebbing, 1908, and *Paralepechinella* Pirlot, 1933) and Prophliantinae (consisting of *Prophlias* Nichols, 1939, *Haustoriopsis* Schellenberg, 1938, *Dexaminoculus* Lowry, 1981, and *Guernea* Chevreux, 1887) [see Table 2]. Bousfield and Kendall (1994) reported slightly less than 200 species in the superfamily Dexaminoidea, occurring in 20 genera, and eight families. They also pointed out that this group showed a high level of morphological diversity and a long evolutionary history, as reflected in the wide geographical dispersion of the genera and the variety of niches and environments occupied.

Members of these subfamilies range from the intertidal zone to depths exceeding 1300 meters. Barnard and Karaman (1991) provided a key to the genera. Ecologically, the family Dexaminidae encompasses a group of nestling amphipods that occur on hard substrates in tropical, warm temperate and polar oceans of the world. The diversity of species and life strategies found among the dexaminids can be partly explained by the abundance of sedentary living substrates upon which they mostly occur. With few exceptions, dexaminids are free living amphipods, typically slow moving, feeding mostly on detritus and employing antennae for filter feeding. Food is selected from the surrounding water from a fixed position, with the amphipod resting primarily upon or within a living substrate (Bousfield and Kendall, 1994). Many exceptions exist to this pattern, such as the sand dwelling species of *Metatiron* and *Atylus* (Bousfield and Kendall, 1994).

Comparative Views on the Higher Classification of the Family Dexaminidae

Bousfield and Kendall (1994) challenged the two subfamily arrangement of Barnard and Karaman (1991) and presented another viewpoint. In a revision of the family, Barnard (1970) previously combined Atylidae Sars, 1895, Anatylidae Bulycheva, 1955, Lepechinellidae Schellenberg, 1926, Prophliantidae Nicholls, 1938, and Dexaminidae Stebbing, 1888 into the family Dexaminidae. Barnard and Karaman (1991) defined the subfamily Dexamininae (Leach, 1813/1814) as dexaminids with pereopods 5-7 of uniform morphology and without an enlarged of coxa 5. Subsequently, Bousfield and Kendall (1994) revised the superfamily Dexaminidoidea Leach, 1813/1814 to include the separate family Atylidae and several new subfamilies. Their decision to merge all the dexaminid-like groups into that superfamily was based on morphologically intermediate species. They rejected the familial concepts of Barnard and Karaman (1991) based on their perception of the authors' failure to recognize the "Darwinian evolutionary thesis that predicts "intermediate" morphotypes between extant and present organisms" Bousfield and Kendall (1994:36). Ishimaru (1994) concurred by stating that the presence of a single taxa that appears to bridge otherwise morphologically discontinuous higher taxa.

Table 2 - Comparative classification schemes of the superfamily Dexaminoidea (after Bousfield and Kendall, 1994)

Barnard and Karaman (1991)	Bousfield and Kendall (1994)
Dexaminidae Leach, 1814	Atylidae Sars, 1882
Dexamininae Leach, 1814	Atylinae Boeck, 1876 (revised)
Atylus Leach, 1815	*Atylus* Leach, 1815
Delkayle Barnard, 1972	Nototropinae Bousfield and Kendall, 1994
Dexamine Leach, 1814	*Nototropis* Costa, 1853
Dexaminella Schellenberg, 1928	*Aberratylus* Bousfield and Kendall, 1994
Lepechinella Stebbing, 1908	Lepechinellinae Schellenberg, 1926

Sebadexius Ledoyer, 1984	*Lepechinella* Stebbing, 1908
Syndexamine Chilton, 1914	*Lepechinelloides* Thurston, 1980
Tritaeta Boeck, 1876	*Lepechinellopsis* Ledoyer, 1982
Polycheria Haswell, 1879	*Paralepechinella* Pirlot, 1933
Paradexamine Stebbing, 1899	Anatylinae Bulycheva, 1955 (revised) 1994
Lepechinelloida Thurston, 1980	*Anatylus* Bulycheva. 1955
Prophliatinae Nichols, 1939	*Kamehatylus* Barnard, 1970 (revised)
Dexaminoculus Lowry, 1981	Dexaminidae Leach, 1813/14
Guernea Chevereux, 1887	Dexamininae Barnard and Karaman, 1991; Ishimaru, 1987
Haustoriopsis Schellenberg, 1938	*Sebadexius* Ledoyer, 1984
Prophlias Nichols, 1939	*Paradexamine* Stebbing, 1899
	Dexaminella Schellenberg, 1899
	Dexamine Schellenberg, 1928
	Delkaryle Barnard, 1972
	Syndexamine Barnard Chilton, 1914
	Dexaminoculinae Bousfield and Kendall, 1994
	Dexaminoculus Lowry, 1981
	Prophliantinae Nichols, 1939
	Prophlias Nichols, 1939

	Guernea Chevreux, 1887
	Haustoriopsis Schellenberg, 1938
	Polycheriinae Bousfield and Kendall, 1994
	Tritaeta Boeck, 1876
	Polycheria Haswell, 1879

does not alone constitute a valid basis for the merging of higher taxa. In addition to resurrecting the family Atylidae Sars, 1895, Bousfield and Kendall (1994) proposed four subfamilies of Dexaminidae: Dexamininae, including *Paradexamine, Sebadexius, Syndexamine, Dexaminella,* and *Dexamine*; Polycheriinae including *Polycheria* and *Tritaeta*; Dexaminoculinae, monotypic with *Dexaminoculus;* and Prophliantinae, including *Guernea, Haustoriopsis,* and *Prophlias.* The superfamily Dexaminoidea (Bousfield, 1979; 1982; 1994) was proposed to contain the families Dexaminidae and the revived family Atylidae Sars, 1882 (containing the subfamilies Atylinae, Nototropiniinae, Lepechinellinae, and Anatylinae), each family occupying branches of the phenogram (Bousfield and Kendall, 1994). Lowry and Springthorpe (2001) provided a detailed description of the family Dexaminidae but provided no comment or to reference to superfamilies or subfamilies. The genus *Polycheria* remained in the Dexaminidae. Bousfield and Kendall (1994) created the subfamily Polycheriinae to contain both *Tritaeta* Boeck, 1876 and *Polycheria* Haswell, 1879, two genera very similar in morphology and ecology.

In this study, the classification of Barnard and Karaman (1991) will be followed, therefore *Polycheria* and *Tritaeta* remain in the subfamily Dexamininae. *Polycheria* is most easily separated from other members of the subfamily and family Dexaminidae by prehensile dactyls on pereopods 3-7, an adaptation suited to its symbiotic lifestyle among sponges and tunicates (Skogsberg and Vansell, 1928; Alderman, 1936). *Tritaeta* is very similar to *Polycheria* morphologically and ecologically (Peattie and Hoare, 1981), but the dactyls on pereopods 3-7 are much larger forming a carpochelate, rather than parachelate, or prehensile, condition as in *Polycheria.*

History of *Polycheria* Systematics

The taxonomic history of this genus is complex. Haswell (1879) described the type species, *Polycheria tenuipes,* based on material from Port Jackson, Australia. Holman and Watling (1983) suggested *Dexamine antarctica* (Stebbing, 1875) as the type species, but Barnard and Karaman (1991) reported that *Polycheria tenuipes* Haswell, 1879 had been selected type of the genus by Barnard (1969a). Haswell (1879) described another species, *P. brevicornis* Haswell, 1879, from the same location as the type species, but did not designate a generotype. Stebbing (1875) described *Dexamine antarctica* from the Ross Sea, based on a specimen collected by Captain John Ross in that body water. In 1878 Stebbing changed *Dexamine antarctica* to *Atylus antarctica* and in 1888, moved *D. kergueleni* (Kerguelen Islands) and *Atylus antarctica* (Stebbing, 1878) to the genus *Tritaeta,* because of their similar morphologies and ecology as commensal organisms on sponges and ascidians.

Choosing to apply Haswell's generic name, Thomson (1882) described *Polycheria obtusa* from the South Island of New Zealand. Barnard (1972), upon refiguring *P. obtusa* and separating it morphologically from *Tritaeta antarctica*, supported Thomson's position. In 1905, Walker described *Polycheria atolli* from the Maldive Islands, in the tropical Indian Ocean, thereby justifying its placement in the genus *Polycheria*, rather than *Tritaeta*, on the basis of the prehensile condition of the dactyls on pereopods 3-7. Chilton (1912) rejected *P. atolli* as a new species, referring it to *Polycheria antarctica,* making the point that sufficient differences could not be found to justify *P. atolli* as separate from *P. antarctica.* In the same paper, Chilton referred back to Stebbing (1906), who had made *Polycheria osborni* Calman, 1898 a synonym of *Polycheria tenuipes* Haswell, 1879, supporting his opinion that only two species of *Polycheria* were known, *P. antarctica* and *P. tenuipes.* Bousfield and Kendall (1994) rejected that synonymy, cited the fact that *P. osborni* possessed sufficient variation in morphology, particularly the length of the palm of the gnathopods, to maintain its full ranking, as described by Calman (1898). Despite disagreements (K.H. Barnard, 1932), Chilton and Stebbing established the foundation of the nomenclatural issues that would surround the genus. *Polycheria antarctica sensu lato* has been most widely reported from the Southern Hemisphere, and over the first third of the 20th century, it became almost the default identification for amphipods attributed to *Polycheria* found during most of the surveying expeditions to the Antarctic and the southern oceans. It was reported in the tropical waters of Indonesia (Barnard, 1976), the Caribbean Sea (Shoemaker, 1935), and the Indian Ocean (Walker, 1904; Chilton, 1912), probably because it was the logical choice in the view of the lack of knowledge of tropical faunas and the variation of the species was considered sufficient to cover a tropical distribution.

Schellenberg (1926) added detail to the understanding of the morphology of *Polycheria* when he applied the concept of the "formae" in the description of *Polycheria antarctica* forma *cristata* from the Kerguelen Islands, South Indian Ocean. Later, working with *Polycheria* around South Georgia Island and the Magellanic area of South America, Schellenberg (1931) collected, figured, and reviewed the known species of *Polycheria* and described a new species, *Polycheria acanthocephala,* from the temperate waters off Mar del Plata, Argentina. At that time, the genus included *P. tenuipes* Haswell, 1879, *P. brevicornis* Haswell, 1879, *P. kergueleni* (Stebbing, 1888), *P. obtusa* Thomson, 1882, *P. antarctica* (Stebbing, 1875), and *P. antarctica* f. *cristata* Schellenberg, 1926. The only near tropical species known at that time was *Polycheria atolli* Walker, 1905 from the northern Indian Ocean and the only other Northern Hemisphere species was *Polycheria osborni* Calman, 1898 from Puget Sound and California, U.S.A., previously synonomized by Chilton (1912), but resurrected by Skogsberg and Vansell (1928). Schellenberg (1931) expanded his application of "formae" by describing *Polycheria antarctica* form *gracilipes*, *P. antarctica* form *dentata*, *P. antarctica* form *similis*, *P. antarctica* form *bidens*, and *P. antarctica* form *macrophthalma*, all from the eastern coast of South America, the Antarctic Peninsula and South Georgia Island as part of the collections from the Swedish Antarctic Expedition of 1901-1903. Schellenberg (1931) established named morphological forms rather than distinct species. While adding some detail to the vague concept of *Polycheria* at the time, this led to problems for later researchers. Subsequent workers continued to use the formae concept, (Stephenson, 1947; Thurston, 1974a; 1974b), although no holotype was assigned and no information was provided in the literature to where the expedition collections of the formae were deposited. Stephensen described *Polycheria* forma *intermedia* Stephensen, 1947 as part of the Norwegian Antarctic Expedition of 1927-29. Thurston (1974a) described a new form from the Signy Islands area of the Southern Atlantic, *Polycheria* forma *acanthopoda* Thurston, 1974, and presented a key to formae of *Polycheria* known to that date. In the case of Schellenberg's (1931) work, Holman and Watling (1983) reviewed his formae from the Southern Ocean, described an additional Southern Ocean form, *Polycheria antarctica* forma *nudus* from the Australian shelf, and clarified some of the differences in the existing forms of *P. antarctica.* In their paper, Holman and Watling listed several older species (*P. tenuipes, P. brevicornis* and *Tritaeta kergueleni*) as synonyms of *P. antarctica.* Barnard's (1970) designation of *Polycheria tenuipes* as the type species of the genus was replaced by *Dexamine antarctica* (Stebbing, 1875), later changed to *Polycheria antarctica.* Several authors have not recognized this synonymy and have retained the former arrangement where the species and forms remain distinct (Barnard and Karaman, 1991; Debroyer and Jazdzewski, 1993; Bousfield and Kendall, 1994) Holman and Watling (1983) made no attempt to revise the genus but accepted Schellenberg's forms (1931) and indicated that some may merit full species status under further study. They also pointed out that Thurston (1974a) developed a workable key to the known forms at the time and that they represented separable and valid morphological entities. Holman and Watling (1983) also stated that, in their examination of the *Eltanin* material, they encountered no intermediate cases and little variation, except in eye size, among the forms and species. The localities and details on the specimens used for the *Polycheria* forma *nudus* were provided, along with recent collection records and museum locations of some of the Schellenberg's other forms. Barnard and Karaman (1991) listed 19 species of *Polycheria* and listed as distinct species the four "formae" of *Polycheria antarctica* from the Southern Ocean that had been proposed by Schellenberg (1931) and Holman and Watling (1983). Barnard and Karaman (1991), in this action, designated no type material and made no apparent effort to report the location or confirm the existence of materials by which the "formae" were described. Debroyer and Jazdzewski (1993), in a list of Amphipoda from the Southern Ocean, drawn from a wide variety of taxonomic works, implied that Barnard and Karaman (1991) had elevated all of the forms of *Polycheria* to full species rank.

Bousfield and Kendall (1994) figured and re-diagnosed *Polycheria osborni* Calman, 1898 from Puget Sound and added two new species, *P. carinata and P. mixillae* from British Columbia. They compared the new species to three Asiatic species from Japan and the east Russian maritimes, particularly *Polycheria japonica* Bulycheva, 1952 described from the region of Vladivostok, SSR. Hirayama (1984), in a general review of the amphipods of the Seto Sea, Japan described *Polycheria amakusaensis* and the sub-species *Polycheria atolli orientalis.* In their review of North Pacific species of *Polycheria,* Bousfield and Kendall (1994) elevated that subspecies to full rank as *Polycheria orientalis* Hirayama, 1984. Work subsequent to Walker (1907) on *Polycheria* in the Indian Ocean produced mostly records of *Polycheria atolli* Walker, 1905 (from the Maldive Islands). This species was reported by several authors. Walker (1904) previously published the species as *Polycheria antarctica* (Stebbing, 1875) from Ceylon, but established it as a separate species in 1905. *Polycheria atolli* was most frequently reported by Griffiths (1973; 1974a; 1974b; 1974c; 1975; 1976) from Southern Africa, Walker, 1907 and Ledoyer, (1968; 1972; 1982) from Madagascar, and Bellan-Santini

(1982) from the Mediterranean Sea. Ruffo and Krapp (2005) listed *Polycheria atolli* Walker, 1905 from the Mediterranean Sea in their catalogue of amphipods in the Museo Civico di Storia Naturale in Verona, Italy. The other report of the genus from European waters is Della Valle (1893) who listed *Polycheria antarctica* (Stebbing, 1875) from the Mediterranean Sea, but did not indicate collection location or origin of the material.

Based upon the morphology of the pereopods 3-7, the closest relative of the genus *Polycheria* is *Tritaeta* Boeck, 1876. Brief mention of the history of this genus is necessary because *Polycheria* was once considered part of genus *Tritaeta*. *Lampra* was described by Boeck (1870) from the British Isles, but because that name was previously occupied by a genus of dragonflies, he created the genus *Tritaeta* Boeck, 1870. Stebbing then (1888) moved his previously renamed *Dexamine antarctica* (Stebbing, 1875) to *Tritaeta* and described a new species *T. kergueleni* (1888) from the *Challenger* material collected in the vicinity of the Kerguelen Islands. Bate (1862) described *Atylus gibbosus* [sic], but this species was placed in *Tritaeta* by Boeck (1876) who noted that, based on mouthparts, *T. gibbosa* is close to *Dexamine,* the genus Stebbing (1888) had previously placed his two species from the Southern Ocean. Boeck (1876) established *Tritaeta gibbosa* as the type species of the genus, but did not comment as to whether the Southern Ocean species of Stebbing (1888) should be placed in *Tritaeta* as well. Boeck (1876) did mention that *Tritaeta* from Western Europe differed significantly from Stebbing's *Tritaeta* species from the Southern Ocean, the northern species possessing a very different shape of the propodus on pereopods 3-7. In *Tritaeta*, the oversized dactyl closes as a simple structure against the carpus whereas in Stebbing's species, *Tritaeta* (= *Polycheria*) *antarctica* and *Tritaeta* (= *Polycheria*) *kergueleni*, the dactyl is much smaller and closes upon a posterodistal protrusion of the propodus, creating a parachelate, or prehensile, condition. Additionally, adult males of *Tritaeta* spp. possess a very distinct notch of the dorsal surface of the propodus of first gnathopod. Conversely, *Polycheria* spp. displays very little sexual dimorphism. In noting the similarities in natural history between *Tritaeta gibbosa* and several species of *Polycheria* (making burrows in sponges and suspension feeding) Boeck (1876) recognized their close relationship, but did not treat them further.

Taxonomic information on the genus *Polycheria* is dated, of mixed quality, highly variable in detail, and so confusing that few specimens collected today could be identified accurately to species with any confidence, except in narrowly defined geographical areas such as California and Magellanic South America where recent comparative studies have been carried out. Thurston (1974a) summarized the problem and little has changed significantly since he related it in the following manner: "Schellenberg (1931) has discussed the variation within *P. antarctica*, rejected Chilton's (1912) assertion that all forms of *Polycheria* belonged to a single species, and described several other new forms. While the validity of these morphological entities cannot be doubted, the significance of the recorded variations is as yet unclear. An analysis of much material from any localities will be required before the status of these variants can be established and an indication given of whether they represent valid species, geographical races, or merely the outward expression of genotypic or phenotypic variations." (Thurston, 1974a: 90). K.H Barnard previously expressed concern about the problem of forms when he pointed out that "although it may be convenient to have several forms united under one name, there is often the danger that specimens may be recorded without an indication of which form they represent, and thus confusing the issue when it is desired to discover whether any particular form is confined to a particular geographical region" (K.H. Barnard, 1930: 390). The most recent work on *Polycheria* is by Hirayama (1984) and Bousfield and Kendall (1994), however, the issues of morphological and biogeographical relationships among the world species and the impact of the near total absence of Western Atlantic material in previous studies remains to be addressed. Table 3 presents an uncritical listing of the nominal species and forms presently attributable to the genus *Polycheria.*

Table 3 – Listing of the species and forms of the genus *Polycheria* Haswell, 1879 (Dexaminidae: Amphipoda) with their type localities or collection location.

Species or Form	Type Locality
Polycheria acanthocephala Schellenberg, 1931	Mar del Plata, Argentina
Polycheria antarctica sensu lato (Stebbing, 1875)	Ross Sea, Antarctica
Polycheria antarctica f. acanthopoda Thurston, 1974	South Georgia Island
Polycheria antarctica f. bidens Schellenberg, 1931	Mar del Plata, Argentina
Polycheria antarctica f. cristata Schellenberg, 1926	Kerguelen Island
Polycheria antarctica f. dentata Schellenberg, 1931	South Georgia Island
Polycheria antarctica f. gracilipes Schellenberg, 1931	South Georgia Island
Polycheria antarctica f. intermedia Stephensen, 1947	Kerguelen Island
Polycheria antarctica f. kergueleni (Stebbing, 1888)	Kerguelen Island
Polycheria antarctica f. macrophthalma Schellenberg, 1931	Strait of Magellan
Polycheria antarctica f. nudus Holman and Walting, 1983	Antarctic Shelf
Polycheria antarctica f. similis Schellenberg, 1931	Mar del Plata, Argentina
Polycheria amakusaensis Hirayama, 1984	Amakusa Sea, Japan
Polycheria atolli Walker, 1905	Maldives, Indian Ocean
Polycheria brevicornis Haswell, 1879	Port Jackson, Australia
Polycheria carinata Bousfield and Kendall, 1994	Vancouver Island, Canada
Polycheria japonica Bulycheva, 1952	Sea of Japan
Polycheria mixillae Bousfield and Kendall, 1994	Vancouver Island, Canada
Polycheria obtusa Thomson, 1882	Patterson Inlet, New Zealand
Polycheria osborni Calman, 1898	Puget Sound, USA
Polycheria orientalis Hirayama, 1984	Shijiki Bay, Japan
Polycheria tenuipes Haswell, 1879	Port Jackson, Australia

Review of ecology and symbiotic behavior of *Polycheria*

In addition to a muddled taxonomy, the ecology of *Polycheria* is also poorly known. Reports of commensal relationships with sponges and tunicates exist, but little information is available on the nature of these relationships. Most host-commensal records of this genus provide little specific information on the host's identity, and the majority of records do not list the host, only the occurrence of *Polycheria* in a field study, inventory, or expedition report (see Table 1). The only detailed study of the ecology and behavior of a member of the genus *Polycheria* was published by Skogsberg and Vansell (1928).

Skogsberg and Vansell (1928) and Ricketts et al. (1968) reported *Polycheria osborni* Calman, 1898 symbiotic with the compound ascidian *Amaroucium* from the Monterey Bay area of California. These authors detailed the behavior of the species on the surface to the host *in situ* and in aquarium studies. Bousfield and Kendall (1994) described *P. mixillae* from British Columbia and reported the host as the sponge *Myxilla incrustans* Bowerbank, 1866. Barnard (1975) reporrted *Polycheria osborni* associated with the compound tunicate *Aplidium* sp. on the central California coast and Vader (1969) provided general notes on the occurrence of *Polycheria* in California along with other genera of amphipods commensal in sponges and ascidians. Many other records of *Polycheria* spp. provide collection data but no details on specific hosts or associated organisms. An early exception was Stebbing (1875) who described *Dexamine* (= *Polycheria*) *antarctica* from materials collected in the Scotia Sea near Antartica, and reported its occurrence with the ascidian *Amaroucium* sp. (Stebbing, 1906). Debroyer et al. (2001), Dauby et al. (2001) and Kunzmann (1996) reviewed and categorized benthic habitats in the Weddell Sea, near Antarctica, and listed amphipod species associated with each habitat, including *Polycheria antarctica* associated with sponges. Dauby et al. (2001) reported *Polycheria antarctica* from the sponge *Crella crassa* Hentschel, 1914 (Demospongiae) from the eastern Weddell Sea. The amphipod was observed to have made hollows in the outer tissue of the sponge by burrowing inward, leaving some posterior appendages exposed, possibly to create water currents. These authors concluded, based upon stomach contents, which consisted of diatoms, mineral particles, and organic debris, these authors concluded that *Polycheria antarctica* was feeding independently of the sponges. This conclusion contrasted with that of Kunzmann (1996) who reported *Polycheria antarctica* in the atrial cavity of unidentified ascidians, and, based upon the analysis of stomach contents that included fragments of the tunic, she concluded that *P. antarctica* was ectoparasitic. This suggests that her definition of the parasitic lifestyle required ingestion the tissues or excavating a domicile in the host's tissue. Debroyer et al. (2001) studied symbiotic and inquilinous microhabitats of *Polycheria* in the eastern Weddell Sea and reported *Polycheria* sp. as a sedentary suspension feeder. In that study *Polycheria* was observed on several species of *Rossella* (Demospongiae) from depths of 118 – 611 meters. In that same study, *Polycheria* was reported from an unidentified gorgonian at a depth of 64 – 110 meters.

The only published records of *Polycheria* from Florida were based on feeding studies of the Gulf Sturgeon in the northern Gulf of Mexico. Mason et al., 1994 reported *Polycheria* sp. from the lower delta of the Suwannee River and Mason and Zengal (1996) reported the same from the Seahorse Key area near Cedar Key. Both specimens were recovered from benthic cores and no data on the hosts were listed or are otherwise available (pers. comm. W. Mason).

Table 4 – Records of hosts for *Polycheria* spp. from literature, museum collections, and personal observations

P. acanthocephala	Sand and gravel, no hosts reported by Schellenberg, 1931
P. f. acanthopoda	"enormous white ascidian" Thurston, 1974: 20 *Distalpia cylindrica* (McClintock, pers. comm.)
P. amakusaensis	No hosts reported by Hirayama, 1984
P. antarctica s.l.	"in sponge" Stebbing, 1906:520; "from sponge" Barnard, 1932:28 *Tedania pectinicola, T. spinata, T. tenucapitata, T. massa, T. charcoli,* (Arndt, 1933 cf. Burton, 1932) *Suberites antarcticus* (Arndt, 1933:XX "from pockets in the surface of a purplish-gray sponge" Shoemaker, 1935 *Halichondria* Barnard, 1916 *Distaplia cylindrica* (Ascidiacea) Bellan-Santini, 1972:184 *Rossella* sp. (hexactinellid sponge) Debroyer et al., 2001 *Crella crassa* Hentschel, 1914 – Dauby, 2001
P. atolli	"frequently recovered from sponges and compound ascidians" Griffiths, 1976:96
P. f. bidens	No hosts reported by Schellenberg, 1931
P. brevicornis	No hosts reported by Haswell, 1879
P. carinata	"from ascidians and sponges beneath boulders" [host not known] Bousfield and Kendall, 1994:92
P. f. cristata	No hosts reported by Schellenberg, 1926
P. f. dentata	No hosts, reported from clay, gravel and algae by Schellenberg, 1931
P. f. gracilipes	*Iophon-Phllophora* (sponge-algae association); *Lithammia;* algae *Dasmerestia menziesii* Thurston, 1974 (Signy Island)
P. f. intermedia	No hosts reported by Stephensen, 1947
P. japonica	No hosts reported by Bulycheva, 1852
P. f. kergueleni	Dredged from bottom on *Challenger*, no host data given by Stebbing, 1888
P. f. macrophthalma	"with algae" Schellenberg, 1931:220
P. mixillae	*Myxilla incrustans* (sponge) Bousfield and Kendall, 1994:44
P. f. nudus	No host provided by Holman and Watling, 1983
P. obtusa	"commensal in ascidians" Barnard, 1972:63
P. orientalis	No hosts reported by Hirayama, 1984 or Bousfield and Kendall, 1994

P. osborni	Calman, 1898 *Amaroucium* (including references below) Staude, 1923 Skogsberg and Vansell, 1928 Ricketts, et al., 1968 Vader, 1969 Skogsberg and Vansell, 1928:281-287, *Amaroucium* Lambert, 1979 *Cystodytes lobata* (ascidian) Abbott and Newberry, 1980 "sponges and tunicates" USNM A342105, label data by J.L. Barnard (Coll. 11/25/1971) "algal wash" USNM 260778, label data by J.L. Barnard (Coll. 3/9/1962) Barnard, 1979:38, *Amaroucium*
P. f. similis	*Amaroucium fuegiensis* Schellenberg, 1931:218
P. tenuipes	*Tedania pectinicola* Schellenberg, 1931:221
Polycheria sp. A	*Amaroucium* sp. (LeCroy, 2004: 480) *Haliclona oculata* (LeCroy 2004: 480) *Leptogorgia virgulata* (LeCroy, 2004: 480) *Eudistoma cf. hepaticum* (pers. obv. J.M. Foster, St. Joseph Bay, FL) *Didemnum cf. candidum* (pers. obv. J.M. Foster, St. Joseph Bay, FL) *Didemnum sp.* undet. (pers. obv. J.M. Foster, St Joseph Bay, FL) *Distalplia bermudensis* (label data, USNM 205641, Alligator Harbor, FL (JLB))
Polycheria sp. (K. Rutzler) Undet. Species	*Ircinia fasciculata* (USNM 139475- Gulf of Tunis, Mediterranean Sea – label data, 8/7/1970) *Ircinia variabilis* - label data, 8/7/1970
Polycheria sp. D new species	*Trididemnum* (USNM 335448, Curaçao, label data, 1/12/1979)

CHAPTER III

MATERIALS AND METHODS

Notes on materials

Much of the comparative materials for this study of *Polycheria* were borrowed from the U.S. National Museum of Natural History, Smithsonian Institution (USNM). This material consists of scattered specimens from various locations around the world: Mexico, Tunisia, New Zealand, Kerguelin Islands, Falkland Islands, and Gray's Reef offshore from Georgia and among the sea islands of Georgia and North Florida (USA), California, and Curacao, and the Gulf of Mexico, along with a few specimens from the cruises of the U. S. Navy research ships *Eltanin* and the *Hero* in the Antarctic region. Material on loan from the Berlin Museum includes all the forms described in Schellenberg's (1931) paper. Other important material, including many specimens of *Tritaeta gibbosa* (Boeck) is on loan from the Zoological Museum of Copenhagen (ZMUC). Materials from several British Antarctic expeditions have been located and examined in the Natural History Museum (British Museum, NHM). Paratype material of *Polycheria carinata* and *P. mixillae* from the British Columbia studies of Bousfield and Kendall (1994) is available at the National Museum of Natural History (NMNH) (pers. comm. E.L. Bousfield) but was not examined. The Australian Museum in Sydney (AMS) provided a large portion of their holdings of *Polycheria* for study, most significantly, material from the type locality of the genus *Polycheria.* Tropical Pacific materials were made available from the personal collections of Ms. Sara LeCroy (Lizard Island, Great Barrier Reef, Australia) and Dr. J.D. Thomas (Indonesia).

For Caribbean Sea material, specimens have been located and received from three sites: Caribbean coast of Panama (Sara LeCroy, GCRL), Curaçao (NMNM), and Puerto Rico (courtesy of Drs. M. Gable, Eastern Connecticut University and D. Plavovet, University of Amsterdam, UVA). Other Caribbean materials include *Polycheria* sp. collected near the Smithsonian Field Station at Carrie Bow Key, Belize by Dr. J.D. Thomas, Nova Southeastern University.

Abbreviations of lending institutions are as follows: Smithsonian Institution – National Museum of Natural History (NMNH), Gulf Coast Research Laboratory, University of Southern Mississippi (GCRL), Southeast Regional Taxonomic Center (SERTC), University of Amsterdam (UVA), Museum für Naturkunde, Berlin (MNB), Australian Museum in Sydney (AM), Zoologisk Museum, Copenhagen (ZUMC), British Museum Natural History Museum (BM-NH), and the Canadian Museum of Nature (CMC).

The study area

St. Joseph Bay, Florida is a 177 square kilometer estuarine lagoon formed between St. Joseph Spit and mainland of Gulf County on the northeastern coast of the Gulf of Mexico (Rupert, 1991; McNulty et al., 1972). It is rectangular in form, 11 km long and 5 – 8 km wide. The average depth of the study area, located in the southern part of the bay, is less than 2 meters. The bay extends northward to the tip of the St. Joseph spit at St. Joe Point, where its wide mouth is formed along a line extending from the northern end of the peninsula to the mainland at the town of Mexico Beach (Fig. 2). St. Joseph Bay is a high salinity lagoon, the salinity remains high (> 30 ppt) most of the year due to its limited freshwater inflow (Rupert, 1991).

Table 5 – Localities sampled for species of *Polycheria* (1999 – 2008)

St. Andrew Bay, Florida	Seagrass meadows adjacent to Shell Island
St. Andrew Bay, Florida, West Pass jetties,	Rock surfaces from the intertidal to 20 m
St. Joseph Bay, Florida	Seagrass meadows throughout the bay
Alligator Harbor and St. George Island Sound, Florida	Seagrass meadows
Florida Keys – Islamorada, Anne's Beach (Little Matecumbe), Zane Grey Creek (Long Key), Grassy Key (borrow pit), Big Pine Key, Spanish Harbor Key, Ohio Key, Bahia Honda Pass	Hard bottoms and seagrass meadows to 10 m
Carrie Bow Cay (Belize)	Coral rubble on back reefs, sponge and ascidians
Little Cayman Island and Grand Cayman Island (British West Indies)	Coral rubble, sponges and ascidians

Collections were made near Blacks Island, a small, elongate (0.1 x 0.5 km) pine island located in the southern third of the bay, during the spring and summer of 2003 through 2008 (with the exception of 2005). The island is surrounded for 1-2 km on all sides with shallow sandy areas and meadows of *Thalassia testudinum* Koenig that occurs in intertidal areas to depths greater than 3 m. Eastward along the northern Gulf coast is Apalachee Bay, a very large, shallow embayment that dominates the northeastern Gulf of

Mexico. Along its intricate shoreline, it supports numerous bayous and salt marshes, the Suwannee River delta, Cedar Keys and several lagoons protected by barrier islands. One such place is Alligator Harbor, a small seagrass dominated lagoon near the town of Carrabelle, Florida. The limestone shelf that lies beneath the shallow water of Apalachee Bay supports a very diverse sponge and ascidian community (De Laubenfels, 1953; Little, 1963; Van Name, 1945.

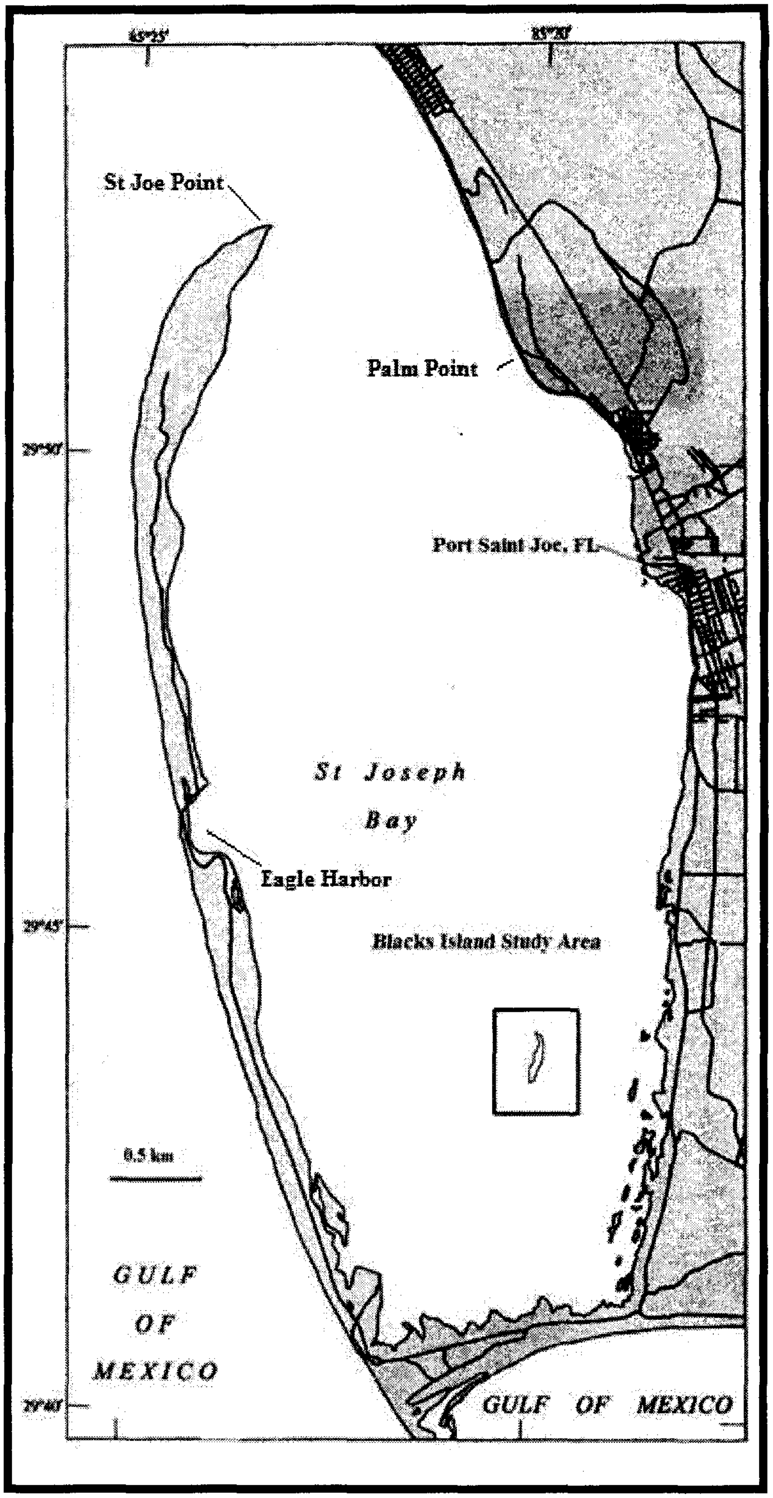

Figure 2 – St. Joseph Bay, Florida, indicating the Blacks Island study area

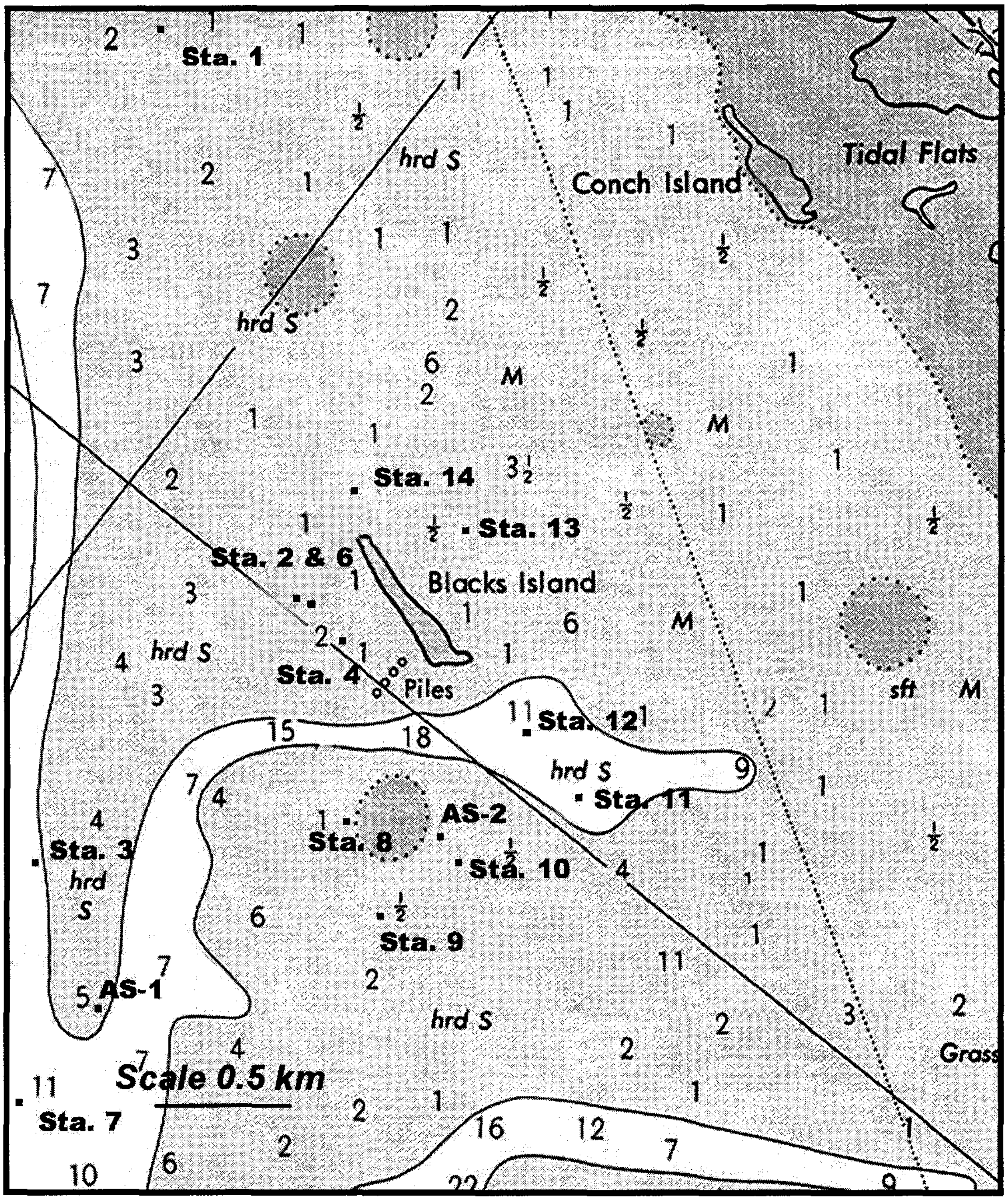

Figure 3 – Collections stations in the vicinity of Blacks Island, St. Joseph Bay, Florida (2003-2008). Modified from NOAA Chart 11393, Lake Wimico to East Bay, Florida.

Collections were made by hand, skin diving, or SCUBA. Tunicates or sponges were placed directly into a plastic zip bag with seawater and sealed underwater. Two artificial substrates were placed in the collection area in July, 2004; substrate number one (AS-1) was recovered in December, 2004. The substrate was constructed of an 8 x 8 inch concrete block filled with quartzite gravel and enclosed with 1.2 cm mesh screen. The substrate was processed by removing sponges, ascidians, or other fouling organisms from outer surface and submerging the block into a bucket of 4% formalin/seawater and washing that material through a 0.5 mm Tyler® sieve. On the boat or ashore, the tunicate and sponge specimens were placed in shallow pans and observed directly for *Polycheria* embedded in the host or dislodged in the bag. Any amphipods dislodged from the host were collected and separated with a 0.5 mm mesh Tyler® sieve. Specimens were labeled and placed in the bag with the tunicate specimen and the original collection water. Upon return to the boat or shore, the bags were placed in insulated containers and returned to the laboratory. If known, the genus of the ascidian was noted, along with field data. Collections were made at 14 stations and two artificial substrates at various depths and distance from the island (Fig. 3; Appendix A). Field data collected included latitude and longitude coordinates Garmin GPS 72. The air temperature (°C), water temperature (°C), and salinity in parts per thousand were determined using a laboratory thermometer and a temperature compensated refractometer. Additionally, the presence and direction of any currents was recorded along with the stage of the tide, wind speed and direction, general notes on the type of bottom sediments, the identity of the seagrasses present, water clarity and if present, notes on other invertebrate fauna and fishes in the collection area.

Photographs were taken *in situ* with a Nikonos 5 underwater camera and a Sealife 6.1 megapixel digital camera.

Laboratory methods

Ascidians were removed from their bags and placed in 8 x 20 cm aluminum pans and examined. Observations and photographs were made of amphipods on the surface of the tunicate samples using a Nikon D 50 digital SLR camera. Sponges were placed in pans and broken apart by hand to locate any *Polycheria* that had burrowed into the tissue. Tunicates were sliced into manageable sections. Water was drained from collecting bags and through a 0.5 mm and 0.3 mm sieve. Amphipods retained on the sieves were placed in 95% ethanol. Tunicates and sponge fragments removed from the bags were examined under a Wild M-5 or M-8 stereoscope to locate any remaining amphipods. A few host specimens were separated before preservation and placed in a 40 L aquarium with seawater from the collection location. The remaining ascidian and sponge specimens were returned to their original plastic bag, covered with fresh 95% ethanol and retained for species identification and/or confirmation by a specialist. All *Polycheria* specimens were placed in labeled vials in fresh 95% ethanol for potential molecular taxonomic work in the future. Other macro-invertebrate organisms retained on the sieves were be placed in 70% ethanol, labeled, and retained for future study or loan to colleagues. A composite collection from each location, including males, females, and juveniles were dissected under a Wild M-5 stereoscope, stained in chlorazal black or lignin pink and mounted in CMC®. Some specimens were mounted in glycerin jelly. To prevent shrinkage and distortion of the specimens, the amphipods were placed in a 10% glycerol solution and dehydrated. Upon the evaporation of the ethanol, specimens were placed in glycerin jelly, stained and mounted. The slides were cataloged by host, date, and locality. Materials borrowed from institutions were examined in the same manner, if permission had been obtained from the lending institution. Each morphological form was illustrated, described in detail, and compared against published illustrations and descriptions. Drawings were made with a Nikon Optiphot Differential Interference Contrast (DIC) microscope with a drawing tube. Drawings were made of *Polycheria* materials collected from various species of tunicates and sponges to order to identify any variants in the collections or any morphological forms that may be limited to a particular host.

For *in vivo* observations, ascidians were placed in 40 L aquaria and photographed with a Nikon D50 digital camera. Some photographs were taken with a Nikon D 70 or D 50 digital camera with an adapter tube and using a copy stand with extensions tubes. Amphipod density was calculated by selecting twenty random 1.0 square centimeter sections of the surface of ten host tunicates of each genus. Occupied burrows were counted within the sample squares. The statistical mean of *Polycheria* specimens that occupied burrows in the twenty square centimeter sections was considered the density for that particular ascidian. Measurements of individuals and burrow size were with an ocular micrometer using a Wild M-5 stereomicroscope. Numbers of eggs from ovigerous females were also made. Gut analysis was performed on ten *Polycheria* specimens. Selected amphipods were placed on a slide in a drop of glycerin after dehydration in 10% glycerol in the manner described above. A fine needle was used to split the cuticle on the ventral side of the amphipod, the gut contents were scraped out on to the slide, and a cover slip was placed on the gut contents. The slides were examined at 100X and 400X using a Nikon Optiphot DIC microscope. Thorough scans of the gut scrapings and the carcass were made to isolate any recognizable organisms. Ascidian and sponge spicules were obtained by soaking tissue fragments 10% Clorox® for several minutes. The spicules were mounted in glycerin jelly and compared to published illustrations of ascidians and sponges to aid in identification of the host species.

Abbreviations – When a specimen is mentioned and referred to as *Polycheria antarctica sensu lato* (sl), it means that from the information provided in the literature, a more precise identification was not possible without examination of the specimen.

Abbreviations

Appendages and body segments will be abbreviated as follows on some plates: Antennae 1 and 2 – A1 and A2; Head – H; mandible – Mnd; Palp – P; Maxillae 1 and 2 – Mx 1 and Mx 2; Upper lip – UL; Lower lip – LL; maxilliped – MXPD; Gnathopods 1 and 2 – GN 1 and GN 2; Pereopods 3 through 7 – P3 through P7; articulated sections 2 – 7 of appendages will be referred to as basis, ischium, merus, carpus, propodus, and dactyl, respectively; Coxal plates 1 through 7 as CX 1 – 7; Pereonites 1 through 7 as PN 1 – PN 7; Urosomites 1 through 3 – USM 1 -2- 3; Telson – T, Uropods 1 through 3 – U1 – U3; Pleonites 1 through 3 as PLE 1--2– 3; Pleon side plates 1 through 3 as E1 – 2 – 3; Pleopods 1 through 3 – PL 1-2-3; gill plates – GP; Oostigites - OOG. Measurements are in millimeters and tenths of millimeters. Other abbreviations: ppt – parts per thousand; coll. – collected by; det. – determined by; m – meters; fig. – figure; f. – form; L – liter. Latitude and longitude are recorded in degrees, minutes, and tenths of minutes.

Phylogenetic methods

Material Studied

Data used in the analysis for this research was taken largely from published records on all known species and forms of the genus *Polycheria*, from personal collections from the Gulf of Mexico and the Caribbean Sea, and from museum collections. Descriptions of these new species appear in chapter IV. Unless otherwise indicated, morphological terminology used in this research follows that of Barnard and Karaman, 1991. Maps were created with ArcMap® and Photoshop 7®.

Data Management and Character Selection

Meristic and morphological data was derived from original descriptions of all known species and forms of the genus *Polycheria,* including those discovered during this research, and the species used as an out-group in the phylogenetic analysis. Measurements to the nearest 0.1 mm were made on enlarged illustrations of the holotype and dissected paratypes of new species. Precise measurement of appendages is provided when permission was granted for dissection of museum material on loan. Text descriptions from the literature were used to supplement, and in some cases to ascertain, certain character states such as simple vs. plumed setae and simple vs. pectinate spines when original illustrations were poorly rendered. Meristic data and character descriptions were entered into a database in order to generate a concise uniform text description for each species and a nexus data matrix for use in the phylogenetic analyses. The database used was the DELTA (Descriptive Language for Taxonomy) format, designed by Dallwitz et al., 1999. It has been adopted as a standard for data exchange by the International Taxonomic Databases Working Group. In generating the nexus file, characters were selected that not only provided diagnostic value in defining a taxon but were considered to be reliable in seeking monophyletic groups defined by shared, derived character states based on comparison with out-group polarity, thus defining phylogenetic relationships among the various species being analyzed. In all, 77 characters were selected that were considered to be unambiguous and that had diagnostic value at the species level.

Data analysis

Dexamine spinosa, a species from the same family (Dexaminidae), but sufficiently different to roots the trees, was selected as an outgroup taxon to establish polarity of the selected character states and to increase the chances of identifying plesiomorphies (ancestral characters). Two taxa believed to be more closely related to *Polycheria (Tritaeta gibbosa* and *Tritaeta chelata*) were included to strengthen the definition of the ingroup node, since more closely related taxa increase the number of characters that can be compared (Nixon and Carpenter, 1993).

The in-group consisted of 22 operational taxonomic units (OTU) comprising the genus *Polycheria* worldwide, including five species newly discovered from this research. The current arrangement and composition of the family Dexaminidae, along with two current views of the family's organization, is presented in Chapter 2.

Phylogenetic analysis.

A heuristic search was conducted in PAUP® 4.0b (Swofford, 2001) on unordered and unweighted morphological characters using a generalized parsimony optimality criterion to find the most parsimonious trees. Stepwise random addition on 100 replicates starting from random trees with a TBR (tree bisection and reconnection) branch swapping algorithm was employed in two steps as described by Olmstead et al. (1993). A strict consensus tree and a majority rule tree were computed from the parsimonious trees results from the heuristic search described above and the trees results from the computed consensus and majority rule were saved. Cladograms were generated using the display Print Trees option in PAUP and the resulting PICT files were modified for display in this research using Photoshop 7 (Adobe Systems, Inc.).

Various tree statistics were computed to indicate how well the character data fit the tree and the extent to which homoplasy (character state similarity not resulting from shared ancestry) permeates the tree topology. These included tree length (TL) which is the number of steps required to achieve the shortest, most parsimonious tree, consistency index (CI), retention index (RI), rescaled consistency index (RC), and homoplasy index (HI); the latter four being indicators of the amount of homoplasy present in the tree and how well the tree describes the data set. The CI, a ratio of the minimal amount to actual amount of character change in the tree, is sensitive to uninformative characters (autapomorphies and symplesiomorphies) while the RI indicates character similarities, regardless of the autapomorphies and symplesiomorphies present, by measuring the amount of synapomorphy (shared derived characters) in the data set based on homoplasy percentages (actual/maximum possible). The RC is a function of the CI multiplied by the RI and approaches one as homoplasy decreases. The HI is merely the reciprocal of CI and approaches zero with decreasing homoplasy.

In the initial character selection process, CI values were used to assess characters for possible inclusion in or exclusion from the analysis. Character diagnostics resulting from a search conducted on an initial 148-character data set revealed some characters with extremely low (less than 0.08) CI values. These were excluded to arrive at the 77-character array used for analysis. Diagnostics for each of the 77 characters used in this analysis are presented in Appendix D.

Optimal trees were evaluated for support using (1) jackknife re-sampling, which systematically removes characters to determine how much the resulting topology is dependent upon a few characters and (2) the calculation of decay indices to estimate branch support on the strict consensus of all trees resulting from parsimony analysis. Also known as "Bremer support" (Bremer, 1994), decay indices indicate how strongly the data supports a particular hypothesis on the tree based on the number of steps required for the branch or clade to collapse. The jackknife analysis was performed as a PAUP functions and decay indices were obtained using TreeRot v.2 (Sorenson, 1999).

MacClade 4.06 (Maddison and Maddison, 2005) was used to trace individual character evolution among clades observed in a strict consensus of the most parsimonious trees generated by PAUP. Diagnostic characters delineating subfamilies, genera and subgenera were examined, and in some cases detected, and marginal, low-consistent characters were evaluated for possible exclusion from further analysis.

CHAPTER IV

SYSTEMATIC SECTION

Diagnosis of *Polycheria* Haswell, 1879

Subphylum Crustacea Brünnich, 1772

Class Malacostraca Latrielle, 1806

Order Amphipoda Latrielle, 1816

Family Dexaminidae Leach, 1814

Synonyms. Dexameridae - Leach 1813/14, vol. 7, p. 432; Dexaminae - Boeck, 1876, vol. 2, p. 310; Dexaminidae - Stebbing, 1888, vol. 29, p. 573, 900; Stebbing, 1906, vol. 21, p. 51; Stebbing, 1910, part 12, p. 602; Dexaminidi - Della Valle, 1893, vol. 20, p. 556; Atylidae - Sars, 1895, vol. 1, p. 461.

Genus *Polycheria*

Type species. Polycheria tenuipes Haswell, 1879 [by selection, Barnard, 1970]

Diagnosis. Body stout, broadest at pereon segments 4 and 5. Head, rostrum very weak, anteroventral lobe rounded or pointed. Eyes large, sexually dimorphic. Antenna 1, flagella usually very setose. Mandible, left and right molar of unequal size, palp absent. Maxilla 1, outer plate with 7-9 spines, fleshy. Maxilliped, palp 4-segmented. Gnathopods weakly subchelate. Gnathopod 1, palm short, propodus not obviously sexually dimorphic. Pereopods 3-7 delicately subchelate, dactyl short, closing on fixed finger; segment 5 short, not expanded or strongly spinose distally, variously shorter than segment 6; segment 2 sublinear, slightly broader in pereopods 6 and 7. Uropod 2, outer ramus usually shorter than inner. Uropod 3, female, rami often unequal. Telson, lobes variously fused basally, lateral margins setose. (Bousfield and Kendall, 1994)

Remarks. There are 22 nominal species or forms reported within the genus *Polycheria.* Based on examination of material from various museums, personal collections, and collections made in the Gulf of Mexico during this study, 12 valid species and 10 morphological forms are recognized, and five new species are described in this report.

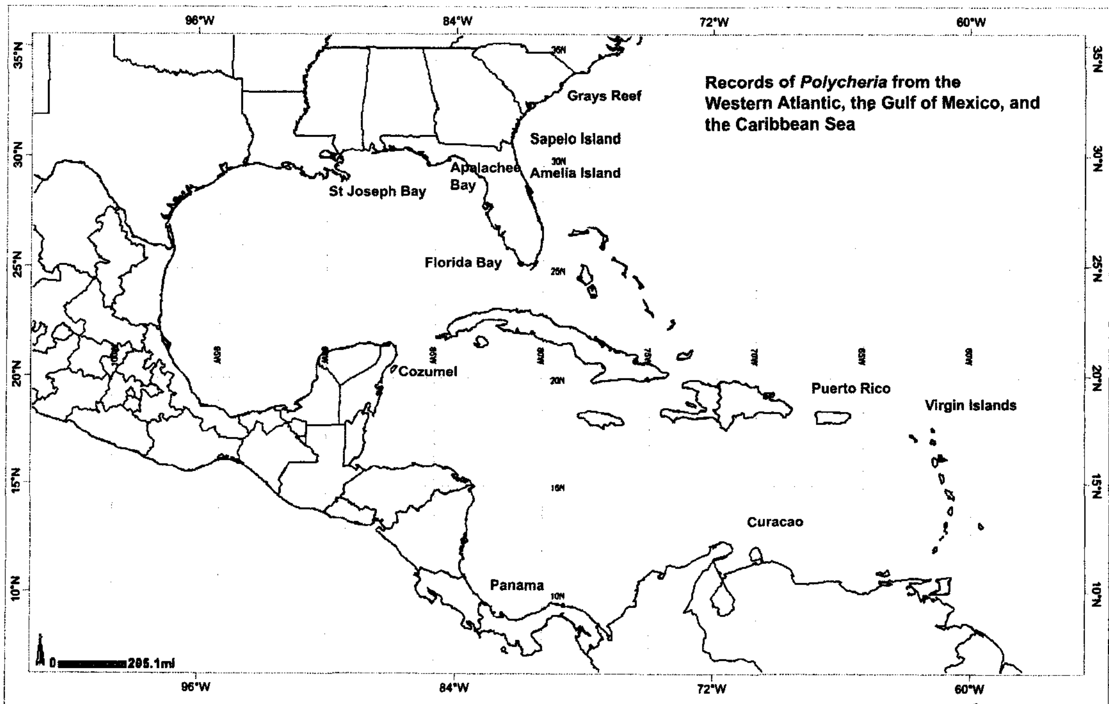

Figure 4 – Distribution of *Polycheria* collections from the Gulf of Mexico and the Caribbean Sea

Western Atlantic species

Polycheria sp. A, new species

Figure 5-7

Synonyms. Polycheria sp. A - LeCroy, 2004: 474, 443, a-h.

Type locality. Blacks Island, St. Joseph Bay, Florida.

Materials: Holotype: ♂ 4.2 mm, host - *Eudistoma* sp., 11 June 2004, St. Joseph Bay, Florida, 200 meters northwest of Blacks Island, 29°43.73'N 85°19.23'W, depth 0.5 meter, 35 ppt, 32°C, coll. J. Foster, USNM 000000.

Paratypes: 1 ♂, 5.0 mm, (mounted slides - illustrated), host *Didemnum* sp., 25 December 1997, Palm Point, St. Joseph Bay, Florida, among algae and tunicates in strand line, 29° 50.45' N 85° 20.10' W, 19°C, 27 ppt, coll. J. Foster.

Other materials examined from type locality. 5 ♂♂ 9 ovigerous ♀♀, host – *Eudistoma* sp., 22 May 2004, St. Joseph Bay, Florida, 400 meters west of Blacks Island, 29° 43.51'N 85° 20.08'W, depth 1 m, 36 ppt, 28°C, coll. J. Foster; 2 ♂♂, 10 ♀♀, host *Didemnum* sp., 11 June 2004, St. Joseph Bay, Florida, 400 m west of Blacks Island, 29° 48.81'N 85° 20.92'W, depth 1 m, 35 ppt, 32°C, J. Foster; 1♂, 1♀, 1 ovigerous, ♀,host *Eudistoma hepaticum,* 14 July 2004, St. Joseph Bay, Florida, 200 m northwest of Blacks Island, 29° 43.73'N 85° 19.23'W, depth 1 m, 33 ppt, 29°C, coll. J. Foster, 1 ♂, 2 ♀♀, 1 ovigerous ♀, 2 juveniles., host *Amaroucium* sp., 20 July 2004, St. Joseph Bay, Florida, 400 m west of Blacks Island, 29° 43.62'N 85° 20.00'W, depth 1 m, 30 ppt, 30°C, coll. J. Foster; 6 ovigerous ♀♀, 23 juvenile, host - *Didemnum* sp., 20 July 2004, St. Joseph Bay, Florida, 200 meters northwest of Blacks Island, 29° 43.73'N 85° 19.23'W, depth 1 m, 33 ppt, 29°C, coll. J. Foster; 3 ♂♂, 2 ♀♀, 1 ovigerous ♀, host *Eudistoma* sp., 20 July 2004, St.

Joseph Bay, Florida, 200 meters northwest of Blacks Island, 29° 43.73'N 85° 19.23'W, depth 0.5 m, 33 ppt, 29°C, J. Foster; 6 ♂♂, 6 ovigerous ♀♀, 14 ♀♀, host *Didemnum* sp., 14 May 2004, St. Joseph Bay, Florida, 200 meters northwest of Blacks Island, 29°43.73' 85°19.82', depth 1 m, 33 ppt, 29°C, coll. J. Foster; 6 ♂♂, 5 ♀♀, beach wash-up of *Didemnum* sp. and algae, 25 December 1997, St. Joseph Bay, Florida, Palm Point, 29° 50.45' 85° 20.10' W, 27 ppt, 19° C, coll. J. Foster; 2 ♂♂, 12♀♀, fouling on *Atrina* shells among *Thalassia testudinum,* 14 May 2005, St. Joseph Bay, Florida, 200 meters north of Blacks Island, 29° 43.73' N 85° 19.82' W, depth 1 m, 32 ppt, 25°C, coll. B Thoma; 4 ♂♂, 1♀, 1 juvenile, host *Eudistoma* sp., on artificial substrate, 4 December 2004, St. Joseph Bay, Florida, 0.6 km southwest of Blacks Island, 29° 43.21' 85° 20.40' W, depth less than 1.0 m, 29 ppt, 10° C, coll. B. Thoma; 3 ♂♂, 2 ♀♀, GCRL 000000, host *Didemnum cf. candidum*, 5 May 1990, St. Joseph Bay, Florida, Eagle Harbor, 29°45.85'N 85°24.25'W; depth less than1.0 m, coll. S.E. LeCroy.

Materials examined outside type locality. 6 ♀♀, USNM 205641, host - *Distaplia bermudensis*, Gulf of Mexico, Apalachee Bay, 8 km off Alligator Point, Florida, 4 February 1955, coll. E.L. Pierce; 1 ♂, host unknown, USNM 238408, Gulf of Mexico, Apalachee Bay, 8 km off Alligator Point, Florida, February, 1960, coll. C.E. King; 1 ♂, USNM 221129, off Georgia, North Atlantic, 20 January 1980, 19 m, suction sample; 1 ♂, NOAA w194MR31, Florida Bay, core sample; 2 ♂♂ 4 ♀♀, 1 juvenile, SERTC S 849, 32 km off St. Catherine's Island, Georgia, 31° 06'N 80° 06'W, 20 m, 20 September 1982; 5 ♂♂, 10 ♀♀, 1 juveniles, SERTC S 847, off Amelia Island, Florida, 30° 06.3'N 81° 01.7'W, 20 m, 4 August 1980, suction device; 2 ♂♂, SERTC S 848, off Sapelo Island, Georgia, 31° 03.9' N 81° 08.6'W, 19 m, 30 January 1980, suction device.

Diagnosis. (Female). Head with, anteroventral margin rounded; coxa, pereopod 3 with acute anteroventral process, length at least three times width at base; epimeral plates 1-2-3 without ventral spines, epimeral plate 3 and epimeral plate 2 with posteroventral setules, epimeral 3 rounded posteroventrally, ventral margin with plumed setae; urosomite 1 with short, elevated process projected posteriorly, urosomites 2-3 with dorsolateral carinae.

Description. Head appendages. Head, anteroventral margin rounded or obtuse, slightly shorter than pereonites 1 and 2 combined. Eye, less than half width of head; eye rounded oval; eye red. Rostrum absent. Antenna 1, subequal to antenna 2; peduncle segment 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, equal to antenna 1; peduncle article 5 shorter than 4; flagellum with 14–15 segments. Mandible, spine row 4 left side 3 on right; molars triturative and unequal in size; palp absent. Maxilla 1, inner plate apex rounded; with one terminal seta; outer plate truncate terminally; outer plate with 6 spines; palp subequal to outer plate; palp sublinear, not tapering distally; palp with 5–6 terminal and subterminal setae. Lower lip, outer lobe not projecting laterally. Upper lip, apical margin broadly rounded with fine lateral and facial setae. Maxilla 2, inner plate half length of outer plate with 3–4 stiff setae; outer plate with terminal plumed setae. Maxilliped, palp segment 4 present; subequal to outer plate; length equal to width of palp segment 3; outer plate inner margin with 15 spines; inner plate greater than one-third length of outer plate; outer plate reaching distal margin of palp segment 4; inner plate with 4 simple terminal setae.

Thoracic appendages. Gnathopod 1, coxa acute anteriorly; coxa, anteroventral margin produced into strong tooth; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anteromedial margin with 4–5 elongate setae and several shorter marginal setae; carpus with facial and posteromarginal setae; carpus longer than propodus; propodus narrowed at base; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae; males without deep notch on anterior margin; palm shorter than dactyl and convex, finely pectinate; dactyl exceeding palm, broadly curved. Gnathopod 2, coxa anterior margin with small triangular tooth produced downward; basis longer than basis of gnathopod 1; merus greater than length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus broad distally; palm short; palm broadly convex; dactyl falcate, with long proximal outer seta. Pereopods 3–7, basis length 3 to 4 times width; prehensile or parachelate; propodus not widened distally; coxal gills weakly pleated. Pereopods 3 and 4, carpus longer than propodus. Pereopods 5–7, coxae each with a short process at the mid-ventral margin. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa less than three times its basal width; posteroventral margin of coxa rounded; basis with postero-distal setae; merus shorter than basis, longer than carpus and propodus combined; merus with 1 short posterodistal spine and 2–3 posterior marginal setae; carpus slightly shorter than propodus; carpus posterodistal and anterodistal margins with short spines; propodus posterior margin produced, with 2–3 distal spines, with 3 anterior marginal spines, and with 1 short distomedial (palmar) spine. Pereopod 4, coxa anteroventral margin produced into blunt tooth, posteroventral margin rounded; anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa rounded; Pereopod 4, basis with several posteromarginal slender setae; merus longer than propodus; merus with 3 short anteromarginal spines. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis longer than merus, with posterior lobe at base; basis with long anteromarginal and posteromarginal setae; merus shorter than carpus and propodus combined; carpus longer than propodus. Pereopod 6, coxa ventral angles rounded; basis with small toothed posterior proximal expansion and subequal to merus; basis with 2–3 anteromarginal spines; merus with 3–4 anterior marginal spines; carpus with anterodistal and posterodistal spines; propodus with 2–3 anteromarginal spines. Pereopod 7, coxa anteroventral angle rounded and rounded posteriorly; pereopods 5 and 7, carpus longer than propodus; basis posterodistal setae and linear; merus shorter than basis; merus with anterior and posterior marginal setae; carpus with anterodistal and posterodistal spines and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus produced distally with 2–3 spines. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; epimera 2 and 3, anteroventral margin with setae; 3, posteroventral margin squared; 3, ventral margin with plumed setae. Urosomite 1, posteroventral margin with several long plumed setae.

Abdominal appendages. Urosomite 1, dorsal margin dorsal keel with acute posterior process. Urosomites 2–3, fused with a mid-dorsal saddle-shaped indentation; 2 and 3, with 0–3 dorsal spines; urosomite 2–3, dorsolateral margins forming keels, running out to form acute lobes. Uropod 1, shorter than uropod 3; peduncle fringed with ventral setae; rami subequal; peduncle subequal to inner ramus; rami with marginal spines and long apical spines on both rami. Uropod 2, shorter than uropod 1; peduncle less than half length of inner ramus; inner ramus shorter than outer ramus; outer ramus subequal to inner ramus; rami with long apical spines. Uropod 3, peduncle shorter than rami; with 2 distal spines; rami wide proximally, tapering to apices; both rami strongly spinose marginally; inner ramus longer than outer ramus; longer than uropod 1 and telson; outer ramus subequal to inner ramus. Telson, broadly lanceolate, acute distally; length more than twice width; cleft at least 90 percent to base; shorter than uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Commensal with compound ascidians in estuarine seagrass communities.

Depth occurrence. 1–20 meters.

Distribution. Gulf of Mexico- Florida: St. Joseph Bay, Alligator Harbor, Seahorse Key, Florida Bay. Western Atlantic: Amelia Island, Florida; Sapelo Island, Georgia; Gray's Reef off shore from Charleston, South Carolina.

Remarks. The copulatory male is characterized by the following (1) pubescence on antenna 2, article 3; (3) long marginal setae on rami of uropod 3; (4) strong row of dorsolateral spines on the peduncle of uropod 1; (5) a row of short spines on the ventral margin of epimera 1-2-3; (6) coxal plates reduced, especially coxa 3 which has no strong anteroventral process, with the exception of coxa 1 which has well developed anteroventral process; (7) uropod 2 with marginal spines at least twice width of the rami.

Remarks: Specimens of *Polycheria* sp. A from St. Joseph Bay, Florida, collected in the preliminary stages of this study, conform morphologically to *Polycheria* sp. A, of LeCroy 2004, from the same locality. Materials examined from the Atlantic coast are also assignable to *Polycheria* sp. A., new species. These include specimens off Georgia (Sapelo Island), South Carolina (Gray's reef) and from Florida (Amelia Island, Florida Bay, and Alligator Harbor) (LeCroy, 2004).

Material from Cozumel, Mexico, examined by McKinney (1977) appears to be distinct from *Polycheria* sp. A. This form, referred to herein as *Polycheria* sp. B, has not been examined by this author, but based on McKinney's description and illustrations; it bears large, stout, curved, ventral spines on the epimeral plates 1-2-3 (2-3-1 spines, respectively). This condition was not observed in any materials examined from Antarctica, South America, Asia, Australia, or the Indian Ocean. *Polycheria osborni* Calman, 1898 bears a row of small spines on the ventral margin of the epimera plate 1, but they are not as nearly as robust as the spines as illustrated on *Polycheria* sp. B. *Polycheria* sp. B may be further distinguished from *Polycheria* sp. A by the presence of a small tooth at the anteroventral angle of the head, the lack of a mid-dorsal process on urosomite 1, and the presence of fewer spines (3 compared to 4-6 spines on species A) on the lateral margins of the telson.

Specimens of *Polycheria osborni* (males and females) are similar to *Polycheria* sp. A. Bousfield and Kendall (1994) examined material from the Gulf of California, described and illustrated the terminal male and the female, but did not differentiate copulatory males from the sub-terminal males which are very similar to females. Copulatory males of *P. osborni* are very similar to those of *Polycheria* sp. A.

Two specimens were collected from St. Joseph Bay that closely resembled the copulatory male of *Polycheria osborni* Calman, 1898 that was illustrated and diagnosed by Bousfield and Kendall, 1994. Two additional specimens of *P. osborni* from the Smithsonian Institution, collected and determined by J.L. Barnard in 1971 (label notes), were examined for this report. In both species, the males were quite similar and were differentiated from females by a larger number of spines on the uropods, epimeral plates, and pereopods. Additionally, the antennae were more setose. However, in both species, the males had much reduced coxal plates, without the strong anteroventral angles of pereopods 3 and 4, common in both *Polycheria osborni* and *Polycheria* sp. A. *Polycheria* is typified by its more conservative sexual dimorphism (J.D.Thomas, per. comm.) in comparison to other dexaminids. Ovigerous females and males, confirmed by the presence of penes on the mesial surface of the basis of pereopod 7, differ in antenna length (females have subequal antennae and males have shorter first antennae) and eye size, with males have slightly larger eyes. The latter character has limited value when comparing large females and smaller males. In the collections from St. Joseph Bay, Florida from at four collection years, males tend to be fewer than females, but certainly not difficult to find. The form of the copulatory male of Bousfield and Kendall (1994) was very rare, with only two specimens observed from about 500 specimens examined. This ratio hardly supports the viewpoint of Bousfield and Kendall (1994) that their male form represents a typical male form. They provided no information on males other than this "supermale" or copulatory form. It is possible, especially in light of the much reduced coxal plates, the "supermale" form is a new species, but a more likely hypothesis is the presence of a rare terminal male form. Only two specimens are available for study, so any decision about a new species would be premature, so this form will be treated as a copulatory male of *Polycheria* sp. A until more material is available.

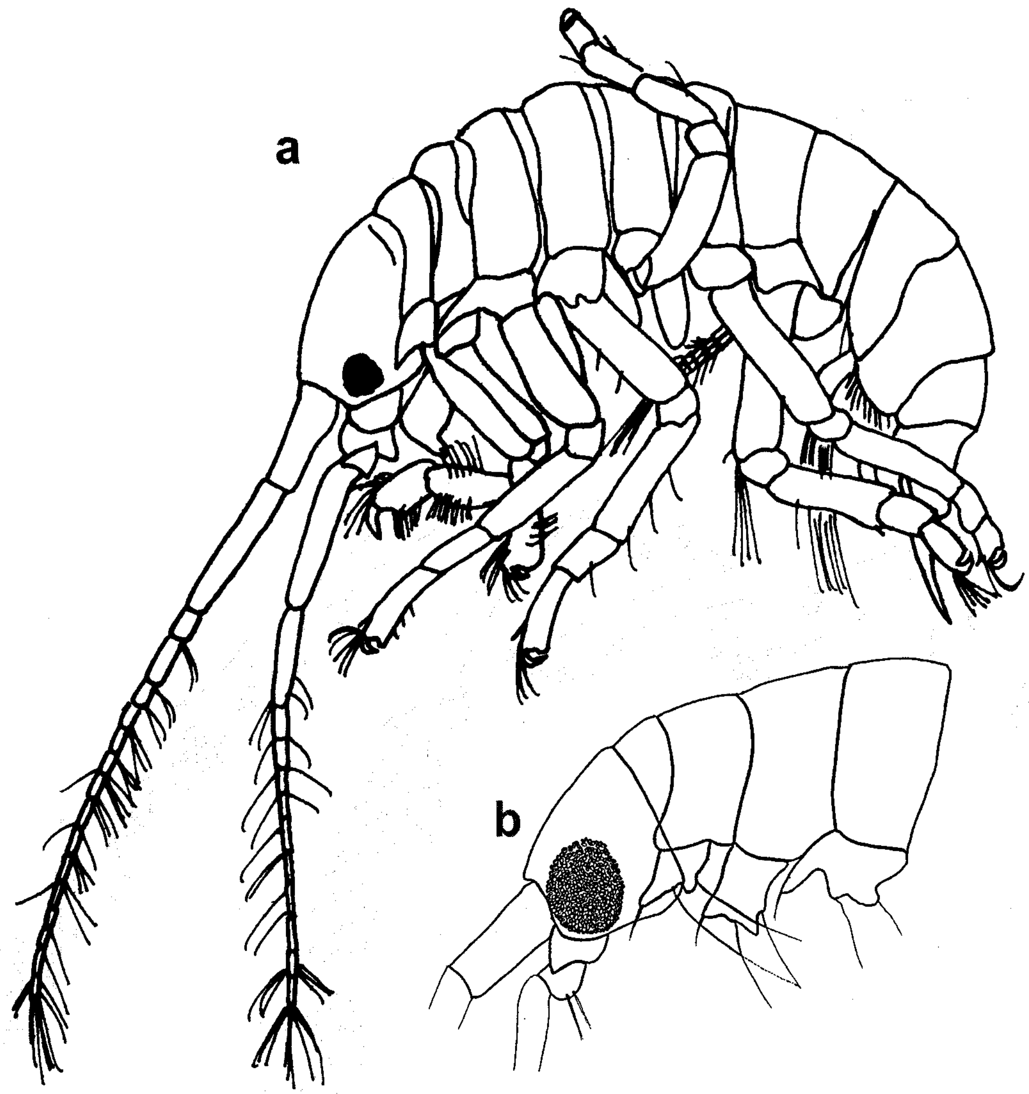

Figure 5 - *Polycheria* sp. A, new species. a, whole animal, juvenile, GCRL 0000, Eagle Harbor, St. Joseph Bay, Florida. Modified from LeCroy, 2004. b, head and pereonites 1-3, ♂, USNM 000000, Blacks Island, St. Joseph Bay, Florida.

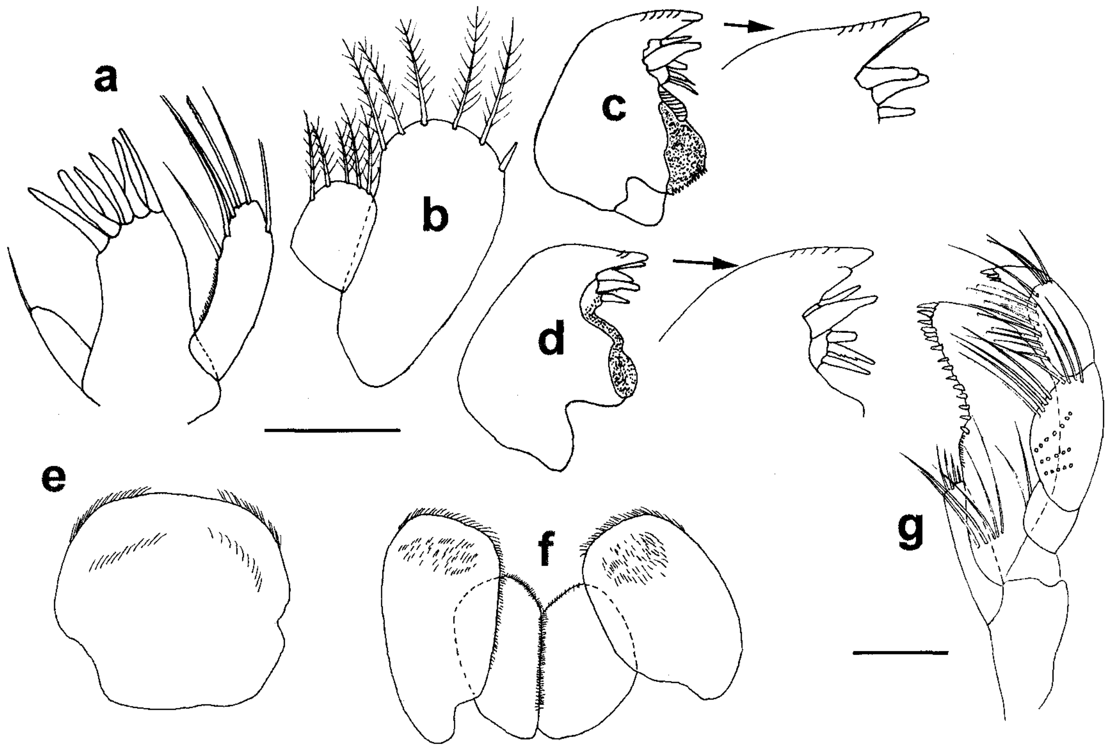

Figure 6 - *Polycheria* sp. A., new species. ♂, 5.0 mm, USNM 000000, Palm Point, St. Joseph Bay, Florida. a, maxilla 1; b, maxilla 2; c, left mandible; d, right mandible; e, upper lip; f, lower lip, g, maxilliped. Scale = 0.10 mm: a – f; Scale = 0.25 mm: g.

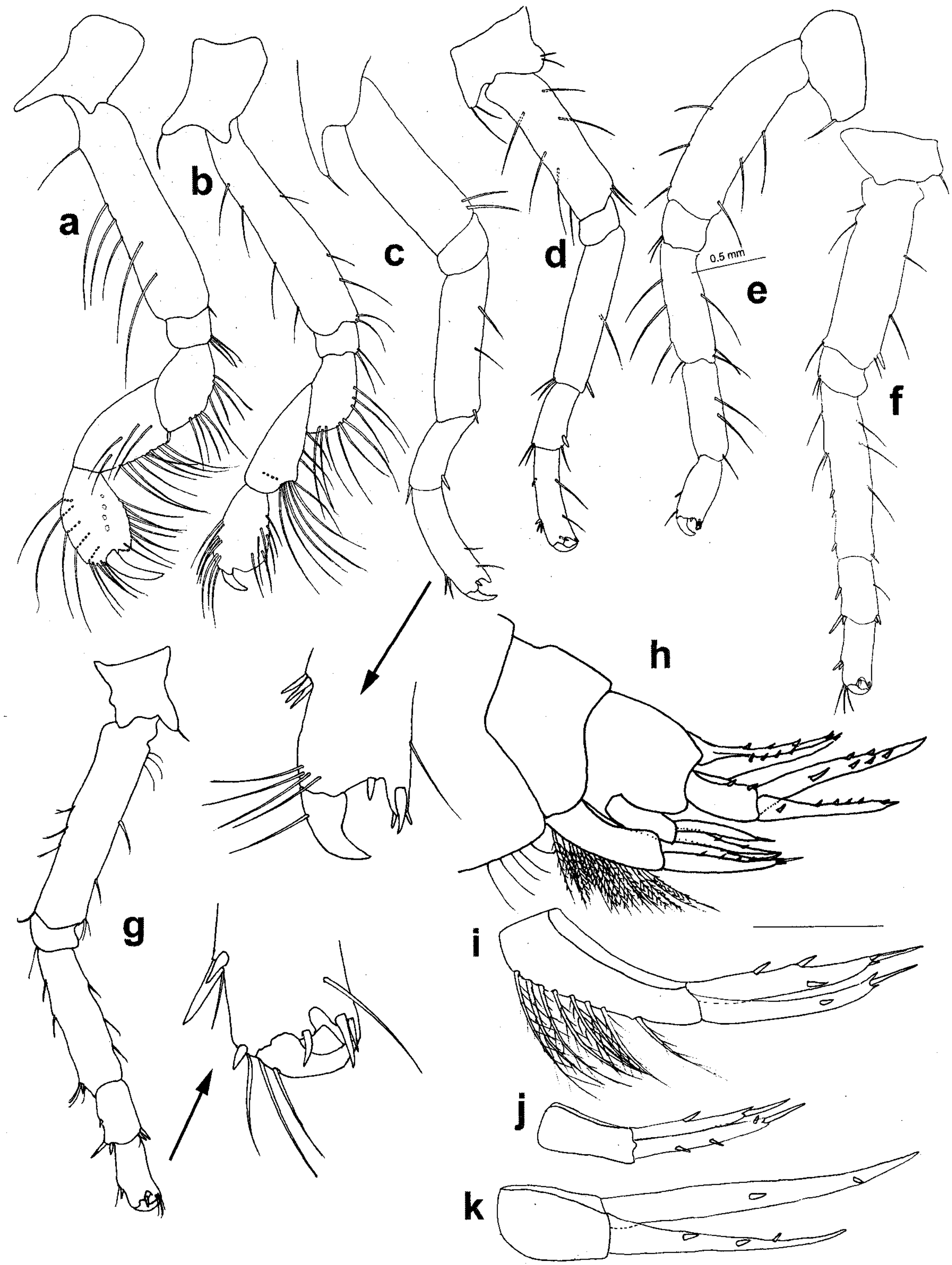

Figure 7 - *Polycheria* sp. A, new species. ♂, 5.0 mm, USNM 000000, Palm Point, St. Joseph Bay, Florida. a, gnathopod 1; b, gnathopod 2; c, pereopod 3 with detail; d, pereopod 5; e, pereopod 5; f. pereopod 6; g, pereopod 7 with detail; h, urosome; i, uropod 1; j, uropod 2; k, uropod 3.

Polycheria sp. B, new species

Figure 8-10

Synonyms. Polycheria sp. A - McKinney, 1977:121–124; 259, fig. 20–22.

Type locality. Cozumel, Mexico [Smithsonian-Bredin Expedition, 1962].

Material. Not located, description from McKinney, 1977.

Type locality. Cozumel, Mexico.

Description. Head appendages. Head, anteroventral margin produced into a small tooth. Eye, one third of width head; eye reniform. Rostrum absent. Antenna 1, subequal to antenna 2; peduncle segment 1 shorter than segment 2. Antenna 2, equal to antenna 1; peduncle articles 4 and 5 equal; flagellum longer than peduncle. Mandible, spine row 2–3; molars triturative, with 3 accessory blades; teeth on lacina mobilis 4; palp absent. Maxilla 1, inner plate apex rounded; with one terminal seta; outer plate truncate terminally; outer plate with 7 spines; palp subequal to outer plate; palp sublinear, not tapering distally; palp with 4 terminal setae. Lower lip, outer lobe projecting laterally. Upper lip, rounded, unproduced. Maxilla 2, inner plate half length of outer plate; with 3–4 stiff setae; outer plate with 7 stiff, plumed setae. Maxilliped, palp segment 4 present; subequal to outer plate; outer plate with strong terminal spine and with 12 short distomedial spines; inner plate one-fourth length of outer plate; outer plate expanded medially; inner plate with 2 terminal setae.

Thoracic appendages. Gnathopod 1, coxa bifid and acute anteriorly; coxa, posteroventral margin produced and bluntly rounded and anteroventral margin produced into strong tooth; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anteromedial margin with 4–5 elongate setae and several shorter marginal setae; carpus posterior margin slightly produced and heavily setose; carpus longer than propodus; propodus short and deep, width 60% of length; propodus shorter than carpus; propodus with heavy facial setae; males without deep notch on anterior margin; palm extremely short, undefined; dactyl bifid distally and exceeding palm, broadly curved. Gnathopod 2, coxa subrectangular, with distal angles acute; basis with posterodistal setae; merus greater than length of carpus; propodus broad distally; palm short; palm defined by two slender distal spines and broadly convex; dactyl bifid distally, or shorter than palm. Pereopods 3–7, prehensile or parachelate; propodus not widened distally. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa three times or greater its basal width; posteroventral margin of coxa acuminate or acute; basis with anterodistal and posterodistal spines and posterior margin with sparse setae; merus longer than carpus and propodus combined; merus with short spines posterodistally; carpus slightly shorter than propodus; carpus posterodistal and anterodistal margins with short spines; propodus posterior margin produced, with 2–3 distal spines, with 3 anterior marginal spines, and with 1 short distomedial (palmar) spine. Pereopod 4, coxa anteroventral margin not strongly produced; anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa rounded; merus longer than carpus and propodus combined. Pereopod 5, basis longer than merus without posterior lobe at base; merus shorter than merus of pereopod 3 and shorter than carpus and propodus combined; carpus subequal to propodus. Pereopod 6, coxa wider than long and ventral margin irregular; merus with 3–4 anterior marginal spines; carpus with anterodistal and posterodistal spines; propodus with 2–3 anteromarginal spines. Pereopod 7, coxa posteroventral margin produced into blunt lobe; pereopods 5 and 7, carpus subequal to propodus; basis posterior margin with 3 strong, upturned spines on proximal half and 3 short spines distally and sublinear; merus shorter than basis; merus with a strong anterodistal spine; carpus with anterodistal and posterodistal spines and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus produced distally with 2–3 spines and with 2–3 anterior spines. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; 2, posterodistally produced, rounded and ventral margin with 2–3 short, curved spines; 3, posteroventral margin posterodistally rounded; 3, ventral margin with plumed setae and one strong spine at posteroventral angle. Urosomite 1, posteroventral margin with long simple setae.

Abdominal appendages. Urosomite 1, dorsal margin low, not produced posteriorly. Urosomites 2–3, fused, with lateral ridges produced posteriorly into lobes; 2 and 3, with greater than 3 dorsal spines. Uropod 1, shorter than uropod 3; peduncle with 3 elongate ventral setae; inner ramus shorter than outer ramus; peduncle subequal to inner ramus; rami inner ramus with 1 apical spine, outer ramus with terminal and subterminal spines, and without marginal spines. Uropod 2, peduncle subequal to rami; rami with long apical spines. Uropod 3, peduncle with dorsal spines; rami lanceolate, distally upturned; inner ramus with 2–3 outer marginal spines and 1 inner marginal spine and outer ramus with 2 outer and 2 inner marginal spines and accessory nail; inner ramus longer than outer ramus; exceeding telson and inner ramus greater than twice the length of peduncle; outer ramus three-fourths length of inner ramus. Telson, triangular, acute distally; width two-thirds length; cleft about 80 percent to base; attaining middle of uropod 3; lateral setation present; with 2 mediodistal spines and 1 pair of mediolateral setules; apical spines absent; apical spines equal to marginal spines.

Habitat. Associated with ascidians on coral reef.

Depth occurrence. Less than 1 m.

Distribution. Caribbean Sea, area of Yucatan Peninsula.

Remarks. This species differs from *Polycheria* sp. A in several character states, as discussed in the remarks to that species. The following table lists characters and character states, comparing species A with species B.

Table 6 – Comparison of characters for *Polycheria* sp. A and *Polycheria* sp. B

Character	*Polycheria* sp. B	*Polycheria* sp. A
Head, shape of anteroventral A/V margin	w/ small tooth	rounded
Head, relative size to body	> pereonites 1 and 2	> pereonites 1 and 2
Eye, width, male	one third	slightly < half
Eye, shape	reniform	rounded oval
Eye, color	?	red
Rostrum, shape or presence	absent	absent
Antenna 1 length compared to antenna 2	subequal	subequal
A1, peduncle one compared to peduncle 2	shorter	shorter
A1, flagellum length	?	14-20 articles
A2, peduncle 4 and 5 comparative lengths	subequal	subequal
Mandible, blades in spine row	2 or 3	3 or 4
Mandible, molar surface	triturative	triturative
Mandible, teeth on lacina mobilis	4	
Mandible, palp	absent	absent
Maxilla 1, shape of inner plate	apex rounded	apex rounded
Maxilla 1, setation	1 terminal seta	1 terminal seta
Maxilla 1, shape of outer plate	truncate distally	truncate distally
Maxilla 1, spine teeth on outer plate	7	6
Maxilla 1, comparative length of palp	subequal to outer plate	subequal to outer plate
Maxilla 1, palp terminal/distal setae	4 terminal	2 term, 3 subdistal

Lower lip, outer lobe shape	poorly produced	
Upper lip, shape	rounded	
Upper lip, development	poorly produced	
Maxilla 2, spines in inner plate	3 to 4	3 to 4
Maxilla 2, spines/setae on outer plate	7	5
Maxilla 2, inner plate length compared to outer plate	0.4	0.3
Maxilliped, palp length to outer plate	slightly shorter	slightly shorter
Maxilliped, outer plate marginal spines	12	15
Maxilliped, palp segment 4	with nail	with nail
Maxilliped, inner plate terminal setae	2	4
Maxilliped, inner plate compared to outer	0.4	0.5
Pereon broadest at segments	4 and 5	4 and 5
Gnathopod 1, coxa, shape of lower margin	acute anteriorly	acute anteriorly
Gnathopod 1, anteroventral process	strong tooth	strong tooth
Gnathopod 1, basis shape	sublinear, < than 3-6	sublinear, = 3-6
GN1, number elongate anterior setae on basis	4	5
Gnathopod 1, carpus setation	lateral, facial, posterior	lateral, facial, posterior
Gnathopod 1, propodus shape	longer than broad	longer than broad
GN1, propodus compared to carpus	longer (1.2)	shorter (.85)
GN1, propodus spination/setation	antero/postero/facial	antero/postero/facial
GN 1, length of palm	shorter than dactyl	shorter than dactyl
GN1, dactyl shape	bifid distally	?
GN1, dactyl length	over lapping palm by 2/3	over lapping palm by 2/3
GN2, coxa shape	a/v margin produced	a/v margin produced
GN2, length of merus compared to carpus	greater than 1/2 length	greater than 1/2 length
GN2, merus posterior setation	elongate setae	elongate setae
GN2, length of propodus to carpus	shorter	shorter
GN2, shape of propodus	broadened distally	broadened distally
GN2, palm length	subequal to dactyl	subequal to dactyl
GN2, palm setation	short marginal; 2 a/v	?
GN2, dactyl shape	bifid distally	?
P3, coxa anteroventral-posteroventral shape	strong tooth; subacute	strong tooth; rounded
P3, coxa a/v process length to width at base	< 3x	< 3x
P3, basis, posteroventral setae	present	present
P3, merus length compared to	subequal/longer	shorter/longer

basis/carpus-propodus		
P3, merus spination	1 short posterodistal spine	1 short posterodistal spine
P3, carpus length compared to Propodus	shorter	slightly shorter
P3, posterodistal margin	produced with 2-3 spines	produced with 2-3 spines
P4, anteroventral margin of coxa	blunt tooth	blunt tooth
P4, posteroventral margin of coxa	rounded	rounded
P4, coxa, P/V angle shape	rounded	rounded
P4, merus length compared to carpus/propodus	?	subequal
P5, coxa, antero and postero ventral angles	rounded	rounded
P5, merus, length compared to carpus/propodus	shorter	shorter
P5, carpus length relative to propodus	subequal	longer
P6, coxa shape, ventral angles	rounded	rounded
P6, basis, number anteromarginal spines	5	4
P6, propodus anteromarginal spines	2 or 3	2 or 3
P6, carpus, anterodistal and posterodistal spines	present	present
P7, coxa shape	bi-lobed, postero-ventrally produced	bi-lobed, postero-ventrally subacute
P7 carpus length compared to propodus	subequal	longer
P7, basis spination	3 strong posterior spines	with posterodistal setae
P7, basis shape	sublinear	sublinear
P7, merus length compared to basis	shorter	shorter
P7, strong anterodistal spine	present	absent
P7, anterodistal and posterodistal spines	present	present
P7, propodus produced with 2-3 spines	present	present
Epimeral plate 1, ventral margin recurved spines	2	0
Epimeral plate 2, ventral margin recurved spines	3	0
Epimeral plate 2, ventral margin recurved spines	1	0
Epimeral plate 3, P/V margin shape	rounded	rounded
Epimeral plate 3, ventral margin with long setae	yes	yes
Urosomite 1, anteroventral margin	yes	yes

with simple setae		
Urosomite 1, mid dorsal carina posteriorly produced	no	yes
Urosomite 2-3, spination	>3	0-3
Urosomite 2-3 armature	fused, lateral ridges	fused, mid dorsal hump
Uropod 1, length compared to uropod 3	shorter	shorter
Uropod 1, rami length compared to peduncle	subequal	subequal
Uropod 1, peduncle ventral setae	3	> 6
Uropod 1, inner ramus subterminal spine	present	present
Uropod 2, rami	uniramous (artifact?)	bi-ramous
Telson, number lateral spines	3 or less	4 to 6
Telson, shape	triangular	broadly lanceolate
Telson, widest	proximally	proximally

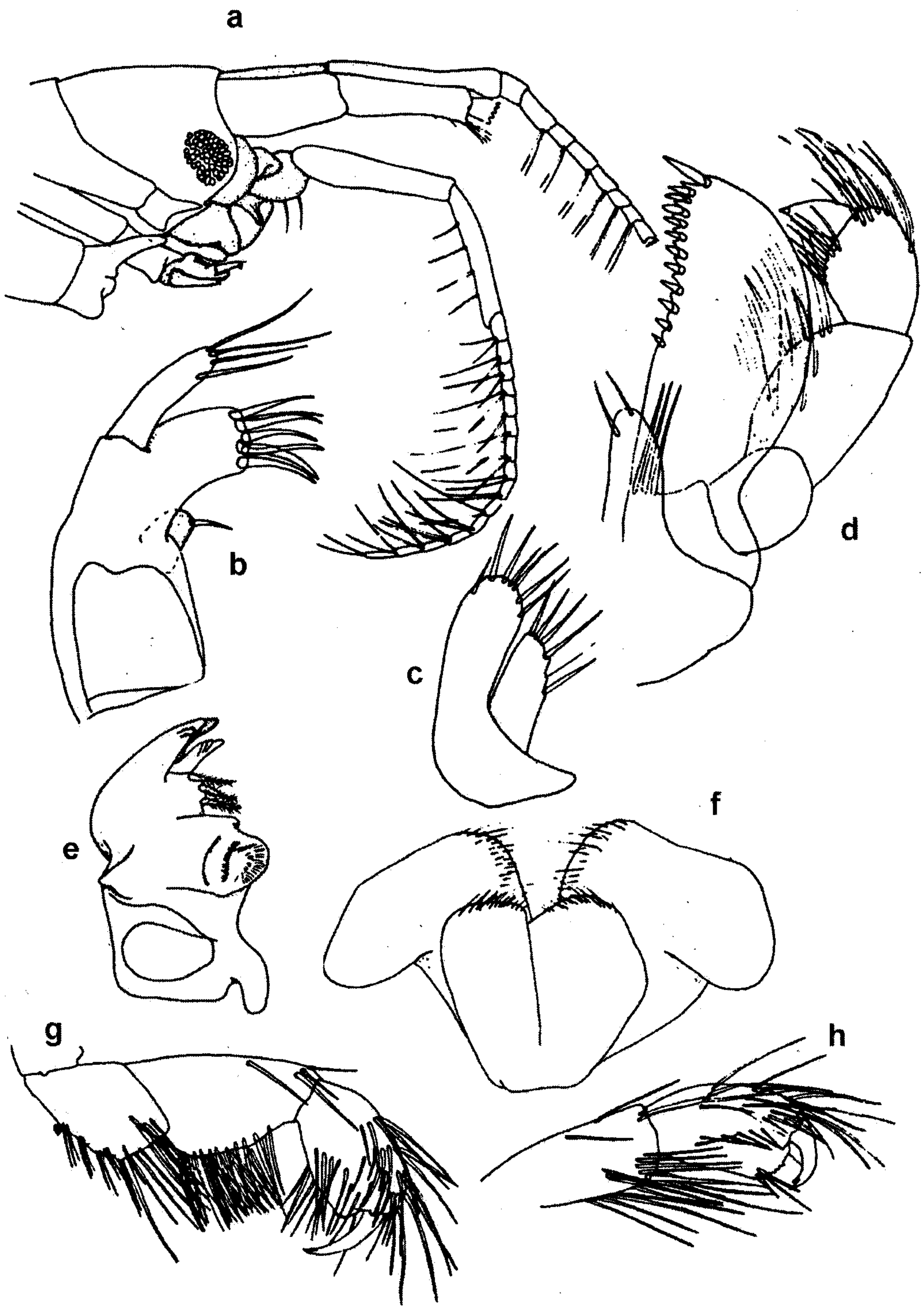

Figure 8 - *Polycheria* sp. B, new species. ♂, 2.5 mm, Cozumel, Mexico. Modified from McKinney, 1977. a, head and antenna 1-2; b, maxilla 1; c, maxilla 2; d, maxilliped; e, mandible; f, lower lip; g, gathopod 1; h, gnathopod 2.

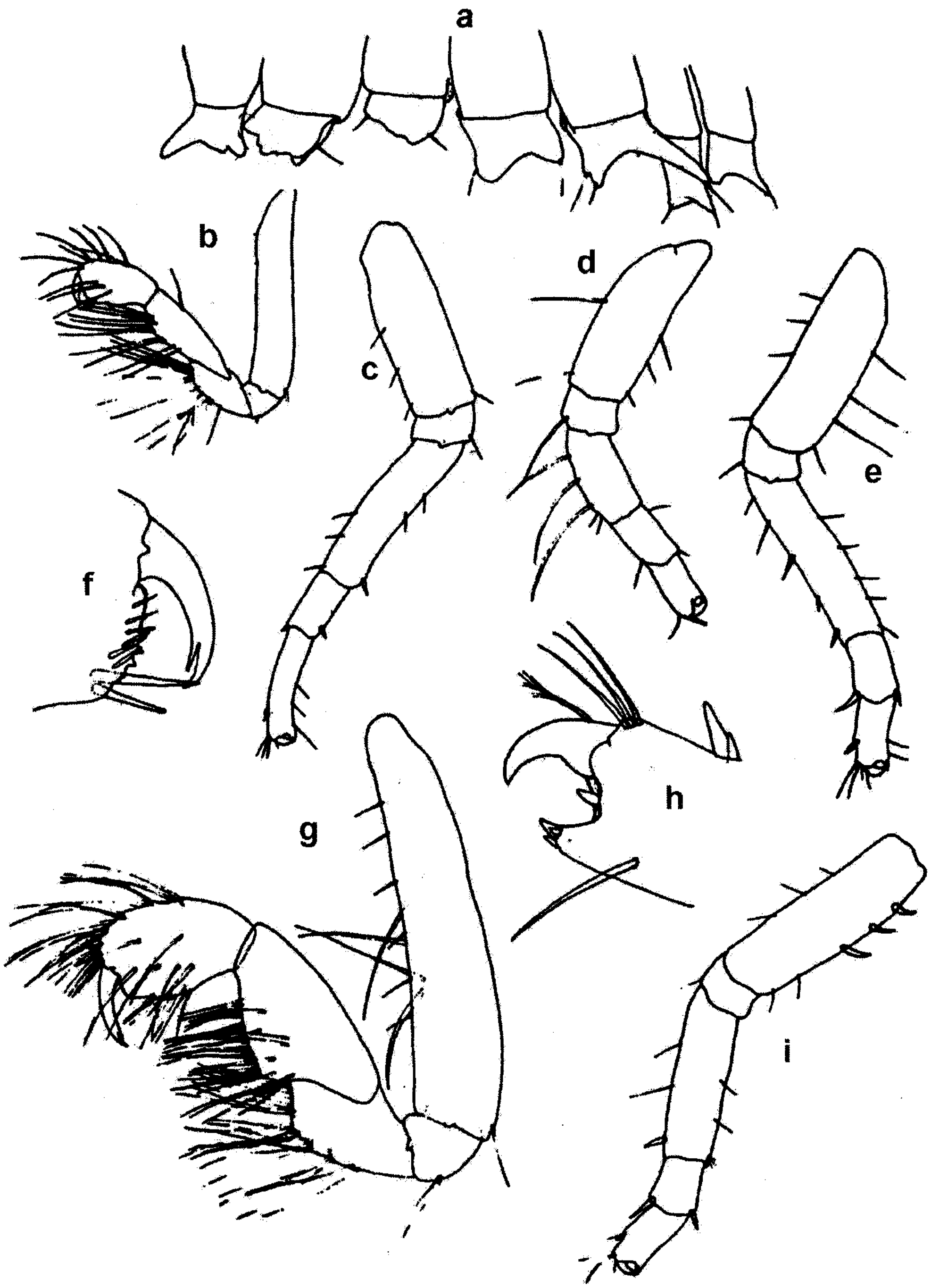

Figure 9 - *Polycheria* sp. B, new species. ♂, 2.5 mm, Cozumel, Mexico. Modified from McKinney, 1977. a, coxal plate 1-7 (left to right); b, gnathopod 1; c, pereopod 3; d, pereopod 5; e, pereopod 6; f, gnathopod 2 detail of palm; g, gnathopod 1; h, pereopod 3 detail of propodus; i, pereopod 7.

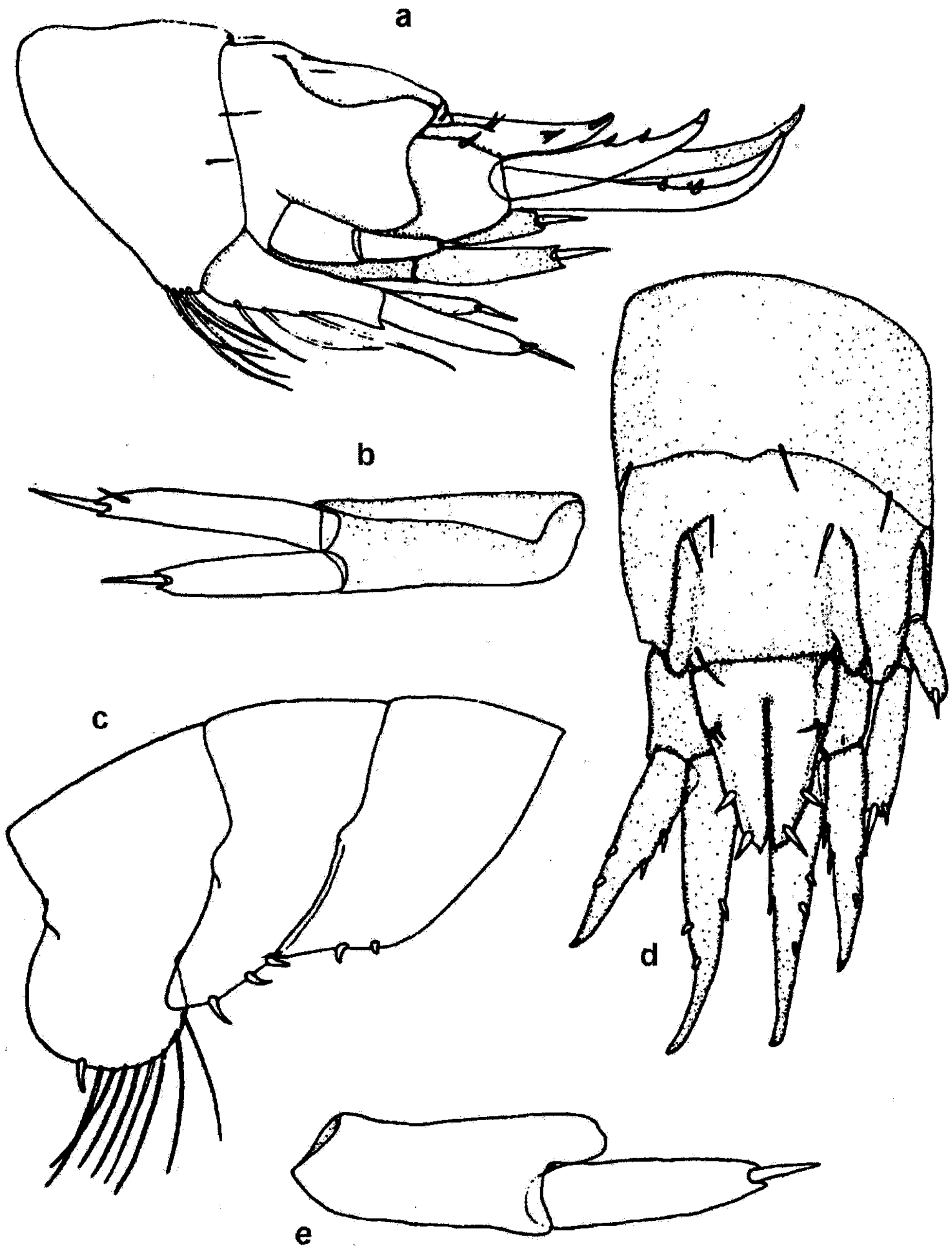

Figure 10 - *Polycheria* sp. B, new species. ♂, 2.5 mm, Cozumel, Mexico. Modified from McKinney, 1977. a, urosome (lateral); b, uropod 1; c, epimeral plates 1-3; d, urosome (dorsal); uropod 2.

Polycheria sp. C, new species

Figure 11

Material: 1 ♂, UVA – PWH 1416, 205294, Puerto Rico, 25 February 1994, coll. D. Platvoet.

Type Locality. Puerto Rico

Description. Head appendages. Mandible, palp absent. Maxilliped, palp segment 4 present.

Thoracic appendages. Gnathopod 1, coxa, distally rounded, deeper than wide; basis sublinear, equal to merus, carpus, and propodus combined; carpus longer than propodus; males (notch) without deep notch on anterior margin. Gnathopod 2, coxa subrectangular with distal angles rounded. Pereopods 3–7, prehensile or parachelate. Pereopod 5–7 merus subequal or longer than carpus and propodus combined. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa three times or greater its basal width; posteroventral margin of coxa produced ventrally as a narrow rounded lobe. Pereopod 4, anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa rounded. Pereopod 5, coxa, deeper anteriorly, tapering posteriorly, with strong anteroventral process. Pereopod 6, coxa ventral angles rounded. Pereopod 7, coxa anteroventral margin produced, bluntly rounded and posteroventral margin produced into blunt lobe; merus shorter than basis; merus with anterior and posterior marginal setae; carpus with anterodistal and posterodistal spines; propodus palm lacking medial spine and produced posterodistally with 1 long curved spine. Pleon segments 1–3 without dorsal teeth.

Abdominal appendages. Uropod 3, rami wide proximally, tapering to apices; outer margin of outer ramus with 1–3 short spines; inner ramus longer than outer ramus. Telson, half as broad as long; cleft about 80 percent to base; lateral setation present; with 2 marginal setae; apical spines absent. Coxa plates 1–4 length less than twice their depth.

Habitat. Unknown

Depth. Unknown

Distribution. Type locality

Remarks: The single specimen from Puerto Rico, referred herein as *Polycheria* sp. C, is considered to be distinct from *Polycheria* sp. A. It differs primarily in the shape of the palm on pereopods 3-7; in *Polycheria* sp. A, the palm is concave to weakly triangular with a short, stout medial spine. In the Puerto Rico material, the palm forms a sub-triangular indention bearing no medial spine. In addition, the posteroventral margin of the propodus possesses a distal tooth and an adjacent parallel spine, creating a slot for the tip of the dactyl to rest. Coxal pates 3 and 4 possesses a much larger anteroventral processes than Species A and the posteroventral process of coxa 3 is more strongly produced than the roundly blunt processes in species A. Uropod 1 does not possess the subterminal spines on both rami as found in species A. Uropod 2 in *Polycheria* sp. B is described and illustrated by McKinney (1977) as being uniramous. The uniramous condition of uropod 2 has not been previously reported in the genus *Polycheria* or in any other members of the family Dexamindae, so this condition is considered the result of damage or some anomaly of development. Uropod 3 bears no dorsal peduncular spines as in *Polycheria* sp. A. The telson of the Puerto Rico material has no marginal spines, only long simple setae, and there are no sub-apical spines as in *Polycheria* sp. A. These characters, if observed in a series of specimens, would probably justify a new species, and perhaps a new genus if the uniramous condition of uropod 2 was found to be consistent over that material rather than an artifact of preservation or development. This specimen is included as a new species because it does not conform to any other known *Polycheria*.

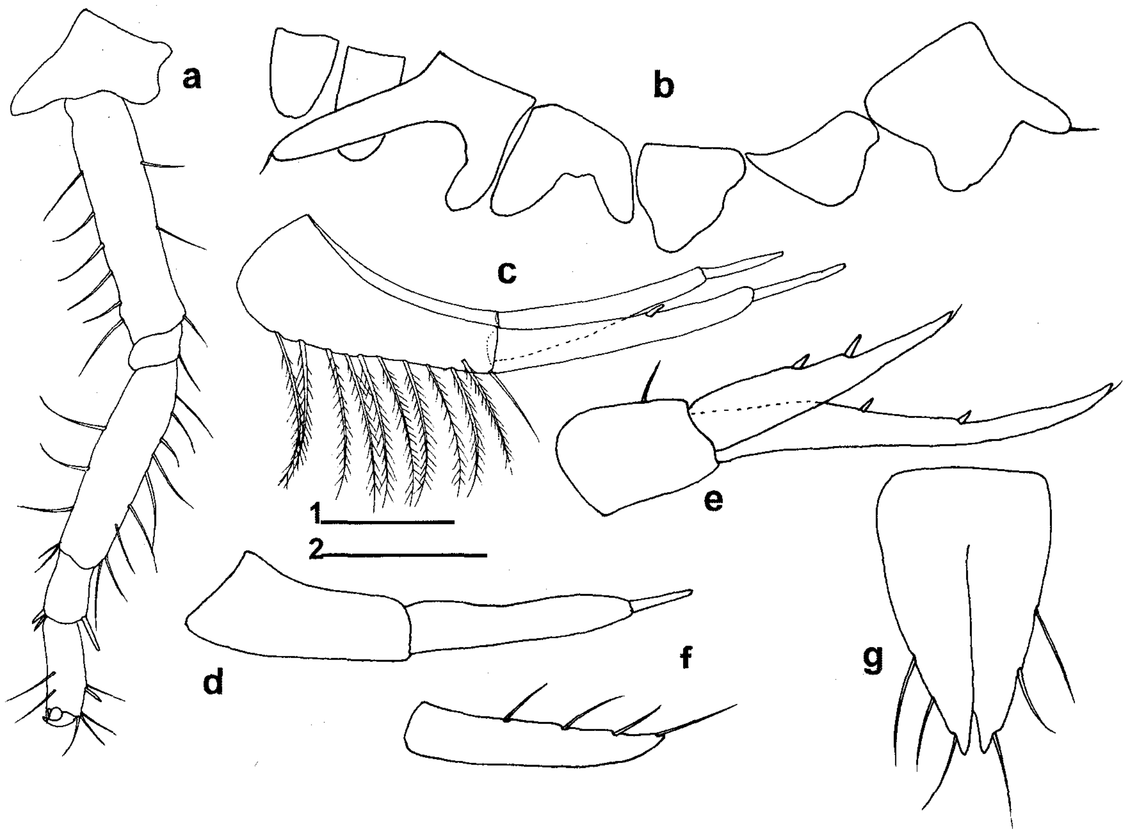

Figure 11 - *Polycheria* sp. C, new species, ♂, 3.5 mm, UVA – PWH 1416, 205294, Puerto Rico. a, pereopod 7; b, coxal plates 1-7 (left to right); c, uropod 1; d, uropod 2; e, uropod 3; f, telson (lateral); g, telson (dorsal). Scale 1 = 0.5 mm: a, b; scale 2 = 0.5 mm; c, d, e, f, g.

Polycheria sp. D, new species

Figure 12

Material. Holotype 1 ♂, 5.0 mm, USNM 000000, allotype - 1 ♀, USNM 000000; Paratypes – 17 specimens, USNM 335448, host *Trididemnum*, San Juan, Curaçao, 19 m, 12 January 1979, coll. F.C. Van Duijl, det., J.L. Barnard.

Description. Head appendages. Mandible, palp absent. Maxilliped, palp segment 4 present.

Thoracic appendages. Gnathopod 1, coxa acute anteriorly; coxa, posteroventral margin produced and bluntly rounded, or anteroventral margin produced into strong tooth; males without deep notch on anterior margin. Gnathopod 2, coxa with a small acute process that the anteroventral margin and posteroventral margin rounded. Pereopods 3–7, prehensile or parachelate. Pereopod 5–7 merus subequal or longer than carpus and propodus combined. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa produced and bluntly rounded; posteroventral margin of coxa produced ventrally as a narrow rounded lobe; basis with posterodistal spines; palm of propodus with 1 medial spine. Pereopod 4, coxa anteroventral margin produced into blunt tooth, posteroventral margin rounded; anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa produced to form blunt tooth and rounded. Pereopod 5, coxa, anteroventral margin slightly produced and anteroventral and posteroventral angles rounded; propodus palm with a short, thick medial spine. Pereopod 6, coxa posterior margin rounded, or with small, rounded anteroventral lobe; propodus palm with short, thick medial spine. Pereopod 7, coxa anteroventral margin produced, bluntly rounded and posteroventral margin produced into blunt lobe. Pleon segments 1–3 without dorsal teeth. Epimeral plate

3, posteroventral margin rounded; ventral margin with plumed setae. Urosomite 1, posteroventral margin with several long plumed setae.

Abdominal appendages. Urosomite 1, dorsal margin with a proximal saddle-shaped concavity and low, weakly toothed behind. Urosomites 2–3, fused with a mid-dorsal saddle-shaped indentation; 2 and 3, with 0–3 dorsal spines; urosomite 2–3, dorsolateral margins with rounded lobes. Uropod 1, shorter than uropod 3; peduncle fringed with ventral setae; rami subequal; peduncle subequal to inner ramus; rami with apical spines. Uropod 2, shorter than uropod 1; peduncle with 3 or 4 dorsolateral spines; inner ramus longer than outer ramus; rami with long apical spines. Uropod 3, peduncle one fourth length of inner ramus; with 1–3 dorsolateral spines; rami wide proximally, tapering to apices; outer ramus with 4 dorsolateral spines; inner ramus longer than outer ramus; exceeding telson. Telson, lateral setation present; with 2–3 lateral spines; apical spines present; apical spines equal to marginal spines. Coxa plates 1–4 length less than twice their depth.

Habitat. Commensal with compound ascidian *Trididemnum* sp.

Depth. 19 meters

Distribution. San Juan, Curaçao

Remarks. Polycheria sp. D falls into Group I of Schellenberg (1931) in that is possesses a round posteroventral margin of the coxa of pereopod 4. It shares the acute posteroventral margin of the coxa of pereopod 7 and the subequal rami on uropod 3 with *P. mixillae.* It shares with *P.* species A the presence of plumed setae on the ventral margins of epimeral plate 3 and the peduncle of uropod 1. This varies from *Polycheria* sp. B in that the setae are replaced with short stiff spines. The anteroventral margin of the coxa of pereopod 3 is quite pronounced, it is not as well developed as in *Polycheria* sp. C. All four of the Western Atlantic species share a few derived characters unique to their group, but are most similar to *P. osborni*. This suggests an ancestral relationship between the East Pacific species and Western Atlantic species (Chapter 5).

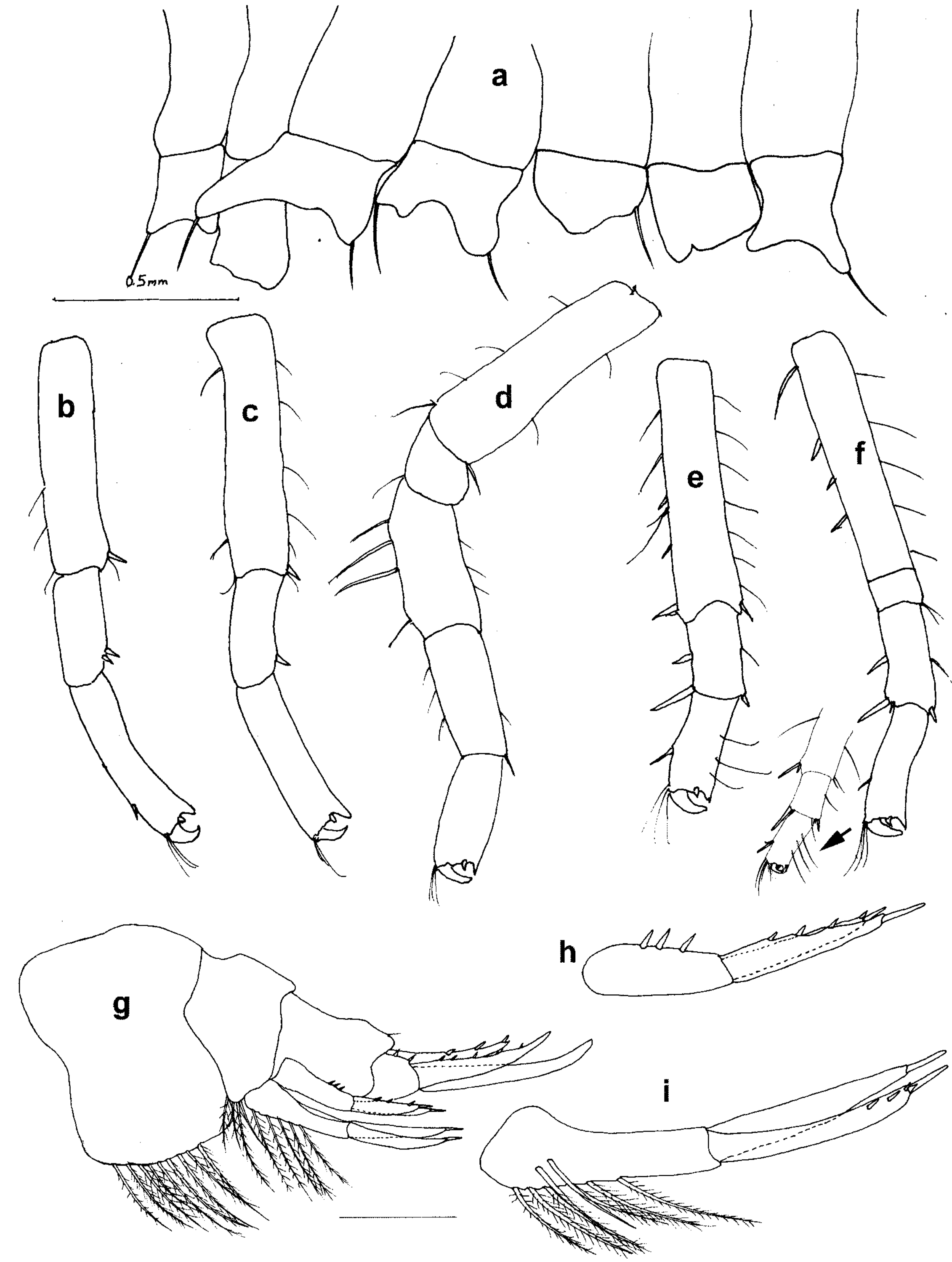

Figure 12 - *Polycheria* sp. D, new species. ♂, 5.0 mm, San Juan, Curacao, Dutch West Indies. a, coxal plates 1-7 (left to right); b, pereopod 3 (less basis and ischium); c, pereopod 4 (less basis and ischium); d, pereopod 5; e, pereopod 6 (less basis and ischium); f, pereopod 7; g, pleosome segment 3 and urosome; h, uropod 3; i, uropod 1. Scale = 0.5 mm – g.

South Atlantic/Southern Ocean species and forms

Polycheria acanthocephala Schellenberg

Figure 13-14

Synonyms. Polycheria acanthocephala Schellenberg, 1931: 221–223, fig. 113 a-h. - Barnard, 1958: 39; Barnard and Karaman, 1991: 272; Gonzalez, 1991: 53; Debroyer and Jazdzewski, 1993: 33; DeBroyer and Rauschert, 1999; 283; Chiesa and Alonso, 2007.

Materials. 3 ♂♂, 2 ♀♀, 2 ovig. ♀♀, coast of North Argentina, 140 km northeast of Mar del Plata, Argentina, ZMCC-CRU-4982, 37° 50'S 59° 11'W. Swedish Subpolar Expedition 1901-1903, 23 December 1901, depth 100 m, sand and gravel, det. S. Bock.

Type locality. Northern Argentina, 140 km east of Mar del Plata; 35° 0'S 56° 11'W.

Description. Head appendages. Head, anteroventral margin produced into a large straight tooth; head large, equal to pereonites 1–2 combined. Eye, one third of width head; eye rounded oval; eye brownish black in alcohol. Rostrum straight. Antenna 1, shorter than antenna 2; peduncle segment 1 short and stout, segment 2 less stout; flagellum with 10–20 articles. Antenna 2, longer than antenna 1 in male; peduncle article 5 longer than 4; flagellum shorter than peduncle, with 10–11 segments. Mandible, spine row 4; molars triturative; palp absent. Maxilla 1, inner plate apex rounded; with one terminal seta; outer plate truncate terminally; outer plate with 9 spines; palp longer than outer plate; palp bluntly acuminate distally; palp with 5–6 terminal and subterminal setae and truncate distally, with several distal teeth. Maxilliped, palp segment 4 present; exceeding outer plate; length less than width of segment 3; outer plate inner marginal spines with 1–5 spines; inner plate greater than one-third length of outer plate; outer plate reaching middle of palp segment 3; inner plate with 5 marginal spines.

Thoracic appendages. Gnathopod 1, coxa rounded below; coxa, anteroventral angle produced; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis without marginal setae or spines; carpus with long setae on posterior margin; carpus subequal to propodus; propodus narrowed at base; propodus subequal to carpus; propodus anterior and posterior margins with long simple and plumose setae; males (notch) without deep notch on anterior margin; palm convex, or subequal to dactyl; dactyl short, strongly curved. Gnathopod 2, coxa distally rounded; basis subequal to basis of gnathopod1; merus greater than length of carpus; merus posterior margin with elongate setae; propodus subequal to carpus; propodus narrowed proximally, subequal to carpus; palm length equal to dactyl; palm distinct, oblique; dactyl strongly recurved proximally. Pereopods 3–7, basis sublinear and length 3 to 4 times width; prehensile or parachelate; propodus not widened distally; coxal gills weakly pleated. Pereopods 3 and 4, carpus shorter than propodus. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa three times or greater its basal width; posteroventral margin of coxa acuminate or acute; basis with posterodistal setae; merus subequal to propodus; merus with 1 posterodistal spine and with 1 posterior marginal spine and 1 posterodistal spine; carpus subequal to propodus; carpus with posterodistal setae; propodus with 1 large curved spine at posterodistal projection. Pereopod 4, coxa anteroventral margin produced into blunt tooth, posteroventral margin rounded; anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa rounded; merus subequal to carpus and propodus combined. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis longer than merus, with posterior lobe at base; merus shorter than carpus and propodus combined; carpus longer than propodus. Pereopod 6, coxa shaped like coxa 5, but smaller and ventral angles rounded; basis longer than merus; merus with 3–4 anterior marginal spines; carpus with 1 medial and 1 distal anteromarginal spines; propodus with strong anterodistal an posterodistal spines. Pereopod 7, coxa rounded posteriorly; pereopods 5 and 7, carpus subequal to propodus; basis linear; merus shorter than basis; merus with a strong anteromedial spine and several anterodistal and posterodistal spines; carpus with anterodistal and posterodistal spines and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus palm with short, strong distomedial spine. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; 2, posterodistally produced, rounded; epimera 2 and 3, anteroventral margin without setae; 3, posteroventral margin with a large triangular tooth; 3, ventral margin with 2 strong curved spines.

Abdominal appendages. Urosomite 1, dorsal margin upturned posteriorly to form a tooth. Urosomites 2–3, with small dorsal spines and paired lateral ridges; 2 and 3, with 0–3 dorsal spines. Uropod 1, shorter than uropod 3; peduncle with a posterodistal spine and distal simple setae; inner ramus shorter than outer ramus; peduncle equal to outer ramus, longer than inner ramus; rami with marginal spines and long apical spines on both rami. Uropod 2, shorter than uropod 1; peduncle slightly longer than rami with 1–4 outer marginal spines; inner ramus shorter than outer ramus; outer ramus shorter than inner; rami with long apical spines and inner margin of inner ramus with 1 or 2 proximal spines.

Uropod 3, peduncle one half length of inner ramus; with a short, distal spine on dorsal margin; rami wide proximally, tapering to apices; outer margin of outer ramus with 1–3 short spines; inner ramus longer than outer ramus; longer than uropod 1 and telson; outer ramus two thirds length of inner ramus. Telson, triangular, acute distally, or broadest proximally; half as broad as long; cleft about 80 percent to base; attaining middle of uropod 3; lateral setation present; with 2–3 lateral spines; apical spines present.

Habitat. Among sand and rocks.

Depth occurrence. 100 meters.

Distribution. Magellanic regions of South America; southern Atlantic Ocean near South Georgia Islands.

Remarks. In this report of Amphipoda from the Swedish Subpolar Expedition, Schellenberg (1931) described many forms of *Polycheria antarctica* (Stebbing, 1875). The only full rank species described was *P. acanthocephala.* This species is easily distinguishable from the other species and forms of *Polycheria* because of the acute, forward projecting processes on the anteroventral margin of the head. *Polycheria obtusa* bears a blunt anteroventral projection of the head, but it is not acute and projects sub-ventrally.

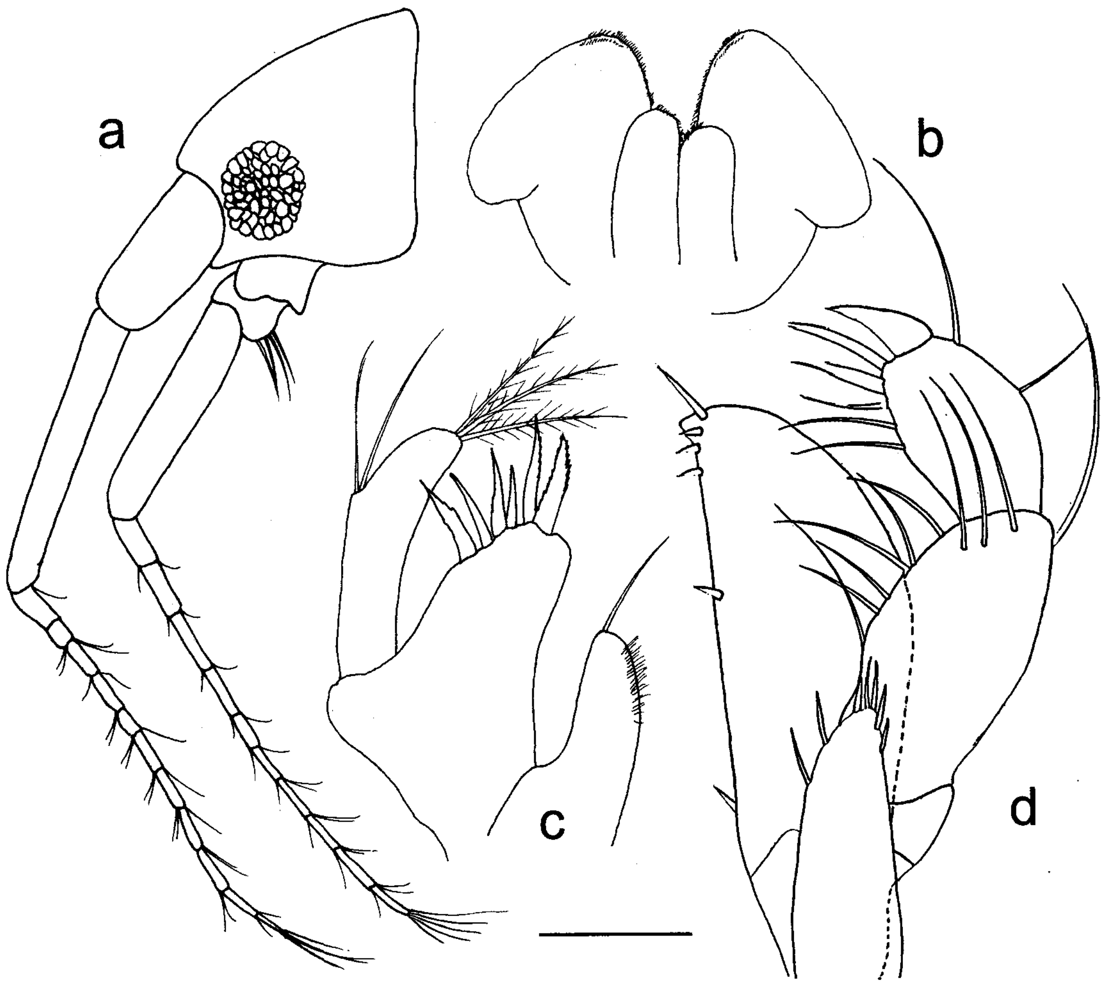

Figure 13 - *Polycheria acanthocephala* Schellenberg, 1931, ♀, Mar del Plata, Argentina, ZMCC-CRU-4982. a, head, antenna 1-2; b, lower lip; c, maxilla 1; d, maxilliped. Scale = 0.1 mm – b, c

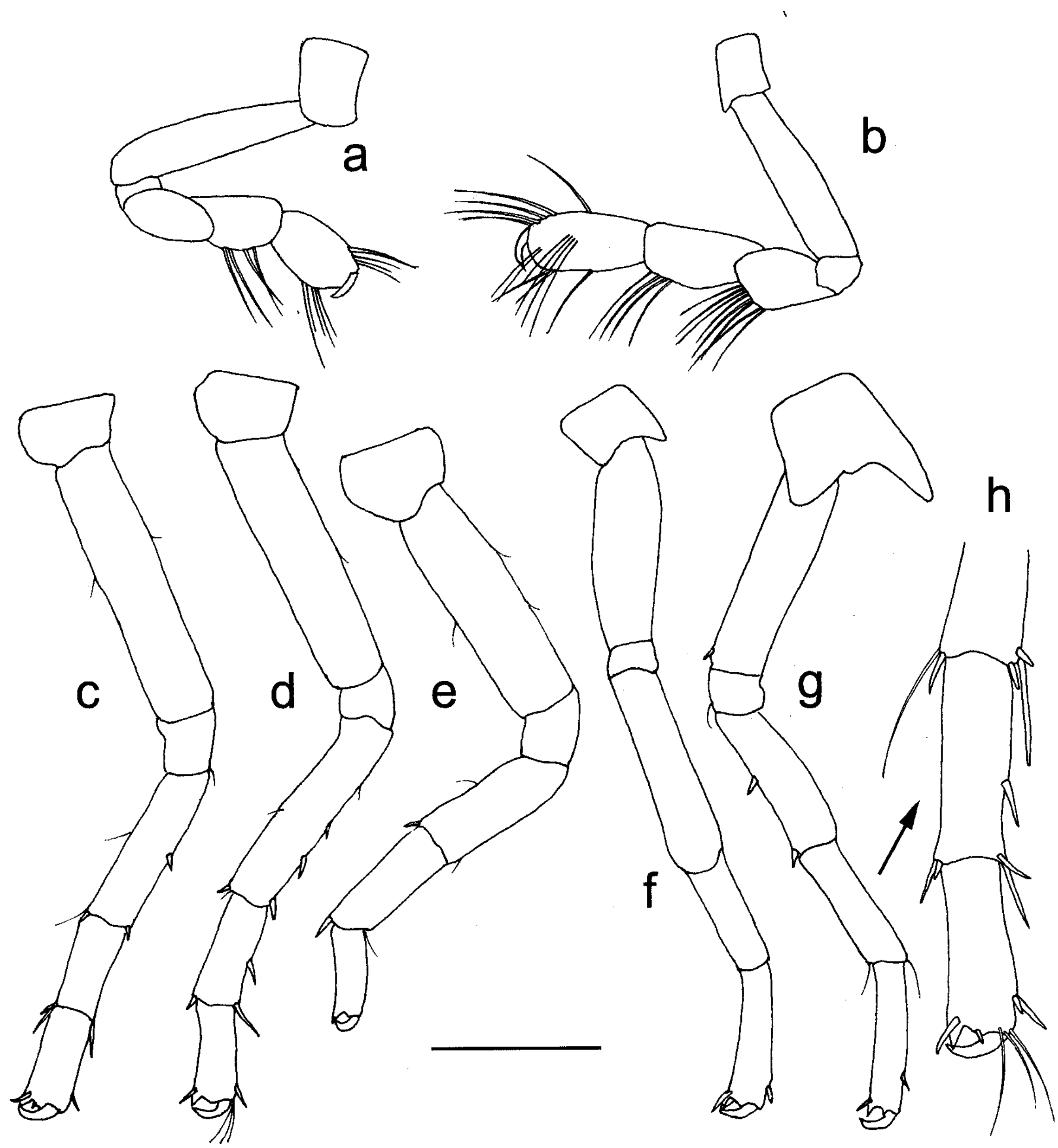

Figure 14 - *Polycheria acanthocephala* Schellenberg, 1931, ♀, Mar del Plata, Argentina; ZMCC-CRU-4482. a, gnathopod 1; b, gnathopod 2; c, pereopod 3; d, pereopod 4; e, pereopod 5; f, pereopod 6; g, pereopod 7; h, pereopod 7 detail. Scale = 0.5 mm

Polycheria antarctica form *acanthopoda* of Thurston

Figure 15-16

Synonyms. Polycheria antarctica form *acanthopoda* Thurston, 1974b: 18–20, fig. 5, a-o. - Lowry and Bullock, 1976: 38; Holman and Watling, 1983: 222–223, fig. 6. *Polycheria acanthopoda* - Barnard and Karaman, 1991: 272; Bousfield and Kendall, 1994: 48, fig. 25–1.

Type locality. Hope Bay, Graham Land, South Georgia, Antarctic Peninsula 63° 24'S 57° 00'W.

Material Examined. 2 ovigerous ♀♀, 7.2 mm and 6.0 mm, "associated with tunicate," Palmer Station, Antarctic Peninsula, 22 March 2007, coll. M. Amsler and J.T. McClintock; 2 ovigerous ♀♀, 4 ♂♂, and 8 juveniles, 54° 50.6'S 37° 23.8'W, USNM, *Isla Orcadas* Cruise 575 Station 90, 7 June 1975, 223-227 m.

Description. Head appendages. Head, anteroventral margin rounded or obtuse. Eye, one third of width head; eye round. Rostrum minute. Antenna 1, subequal to antenna 2. Antenna 2, equal to antenna 1; peduncle article 5 longer than 4. Mandible, palp absent. Maxilla 1, inner plate apex rounded; with one stout terminal spine; outer plate with 11 spines; palp with stout setae on lateral margin. Maxilliped, palp segment 4 present; exceeding outer plate; length equal to width of palp segment 3; outer plate inner margin with 15 spines; inner plate one-third length of outer plate; outer plate reaching middle of palp segment 3; inner plate with 7–8 spines on distal half of inner margin, several terminals spines.

Thoracic appendages. Gnathopod 1, coxa rounded anterodistally; coxa, distally rounded, wider than deep; carpus longer than propodus; propodus shorter than carpus; males (notch) without deep notch on anterior margin. Gnathopod 2, coxa subrectangular with distal angles rounded; basis with posteromarginal setae; merus greater than length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus 2 to 2.5 times longer than wide; palm length equal to dactyl; palm distinct, oblique; dactyl strongly recurved proximally. Pereopods 3–7, prehensile or parachelate. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa three times or greater its basal width; posteroventral margin of coxa rounded; basis anterior and posterior margins spinose; merus longer than propodus; merus with several large posteromarginal spines and posterodistal spines; carpus slightly shorter than propodus; carpus posterodistal and anterodistal margins with short spines; propodus with 1 large curved spine at posterodistal projection, or with 3 anterior marginal spines; palm of propodus deeply recessed, subtriangular. Pereopod 4, coxa anteroventral margin with long blunt tooth, posteroventral margin rounded; anteroventral angle of coxa produced to form long sharp tooth three times its basal width; posteroventral angle of coxa rounded. Pereopod 5, coxa, anteroventral and posteroventral angles rounded. Pereopod 6, coxa with small, rounded anteroventral lobe. Pereopod 7, coxa anteroventral angle rounded and rounded posteriorly; basis linear; merus subequal to carpus and propodus combined; dactyl less than half length of carpus. Epimeral plate 2, with small tooth; 3, posteroventral margin with tooth; 3, ventral margin convex with 5 long setae. Urosomite 1, posteroventral margin with long simple setae.

Abdominal appendages. Urosomite 1, dorsal margin weakly carinate without strongly projecting tooth. Urosomites 2–3, fused, with lateral ridges produced posteriorly into lobes and fused with a mid-dorsal saddle-shaped indentation; 2 and 3, with greater than 3 dorsal spines; urosomite 2–3, dorsolateral margins with rounded lobes. Uropod 1, shorter than uropod 3; peduncle with strong row of short spines on inner and outer dorsolateral margins and fringed with ventral setae; inner ramus shorter than outer ramus; peduncle subequal to inner ramus; rami with apical spines, outer ramus with dorsolateral spines, and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle subequal to rami; inner ramus subequal to peduncle; outer ramus subequal to inner ramus; peduncle and rami strongly spinose. Uropod 3, peduncle one half length of inner ramus; with a short, distal spine on dorsal margin; rami wide proximally, tapering to apices; inner ramus with several marginal setae and both rami strongly spinose marginally; inner ramus twice length of peduncle; inner ramus greater than twice the length of peduncle; outer ramus slightly shorter than inner. Telson, broadest medially; half as broad as long; cleft about 80 percent to base; shorter than uropod 3; lateral setation present; with 2–3 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Associated with colonial ascidians.

Depth occurrence. 73–257 m.

Distribution. Antarctic Peninsula, South Georgia Islands.

Remarks. Holman and Watling (1983) reported *Polycheria antarctica* form *acanthopoda* from South Georgia Island, east of the Antarctic Peninsula, at a depth of 233-272 m. The description provided in this report is based on a specimen collected at Palmer Station, Antarctic Peninsula. The form was described by Thurston (1974) from Hope Bay, Graham Land, near the Antarctic Peninsula because he was unable to match the morphological characters with any known species or forms of *Polycheria.* Schellenberg

(1931) divided the known species and forms of *Polycheria* into two large groups. Group II was represented by taxa with an acute posteroventral process on coxa 4. *P. antarctica* f. *acanthopoda* falls into Group I, taxa with rounded posteroventral lobes on coxa 4. It can be separated from the previous forms (Schellenberg, 1931) by the following characters. It differs from *P. antarctica* f. *kergueleni* by the shape of the urosome, the rounded margin of coxa 2, and the armature of the uropods and the telson. It differs from *P. antarctica* f. *dentata* by its much less produced epimera, and having article 5 of antenna 2 longer than article 4. *Polycheria antarctica* f. *acanthopoda* can be separated from *P. antarctica* f. *cristata* by the weaker carination and spination of the urosome and its shorter, and the stout propodus on gnathopod 2. It differs from *P. antarctica*. f. *gracilipes* by its stout pereopods, rounded coxa 7, the subequal condition of its uropod rami, and its shorter telson. Figure 17 illustrates the coxal plate 1 and 4 in several forms of *Polycheria* as defined by Schellenberg (1931).

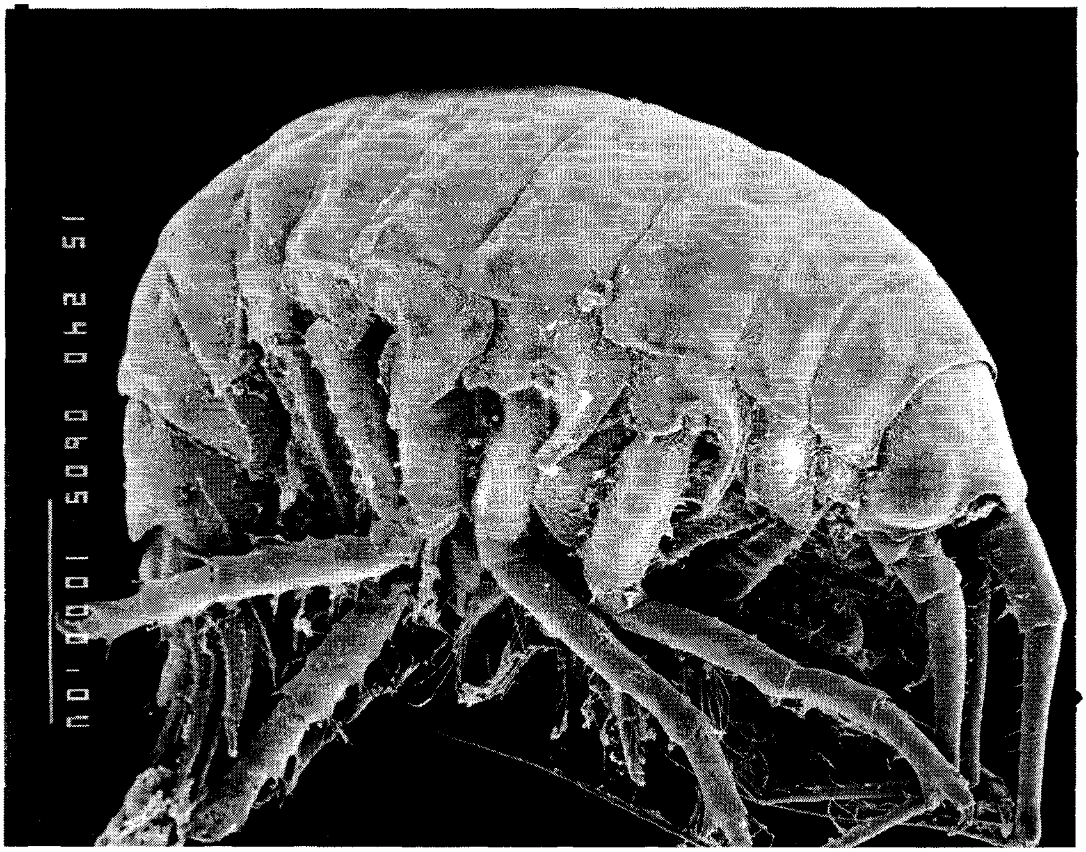

Figure 15 – *Polycheria antarctica* form *acanthopoda* Thurston, 1974. ♀, Palmer Station, Antarctic Peninsula. Scanning electron photomicrograph courtesy of Dr. James McClintock, University of Alabama at Birmingham. Scale = 1.0 mm.

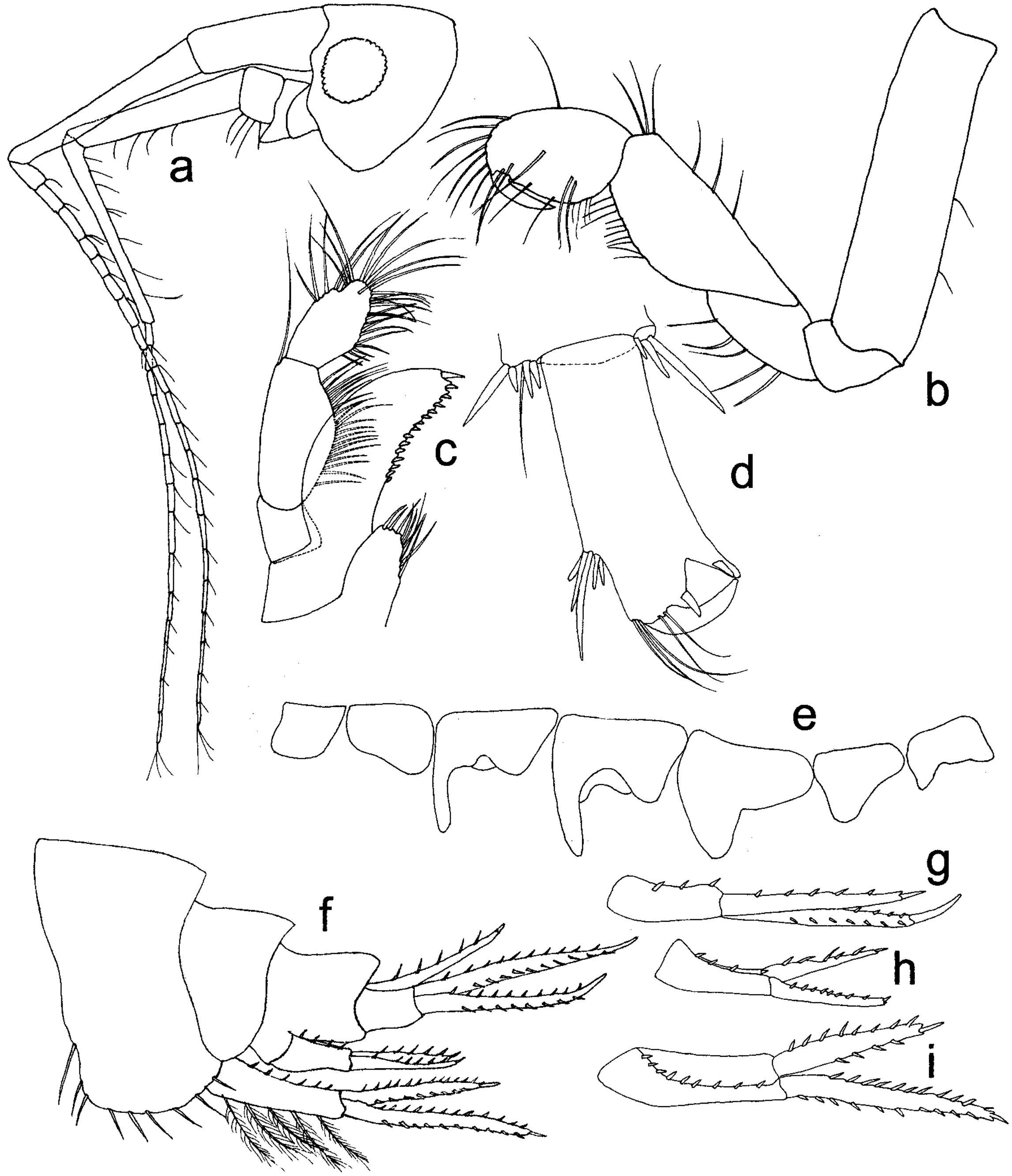

Figure 16 – *Polycheria antarctica* f. *acanthopoda* Thurston, 1974, ovigerous ♀, Palmer Station, Antarctica Peninsula. a, head, antenna 1-2; b, gnathopod 2; c, maxilliped; d, pereopod 7 - carpus and propodus; e, coxal plates 1-7 (left to right); f, pleonite 3 and urosome; g, uropod 3; h, uropod 2; i, uropod 3.

Polycheria antarctica (Stebbing)

Figure 17-19

Synonyms. Dexamine antarctica - Stebbing, 1875: 184, pl. 15A, fig. 1 a-d. – *Atylus antarctica* Stebbing, 1878; 370 [senior homonym]. – *Tritaeta antarctica* Stebbing, 1888: 451, 513, 941; Della Valle, 1893: 580, pl. 58, fig. 83–84; Walker, 1904: 266, pl. 4, fig. 25 [referred to as *P. atolli* by K.H. Barnard, 1930] . – *Tritaeta kergueleni* Stebbing, 1888: 941, pl. 83. – *Polycheria tenuipes* Haswell, 1879: 345, pl. 22, fig. 8. – *Polycheria brevicornis* Thomson, 1882: 263; Stebbing, 1906: 520, fig. 90–91. – *Polycheria antarctica* - Walker, 1907: 34; Stebbing, 1910: 644; Chilton, 1912: 502f; Chilton, 1912: 62; Chilton, 1921: 77; Schellenberg, 1926: 370, fig. 58; Hale, 1929: 216, fig. 214; K.H. Barnard, 1930: 389, 390–391, 448: fig. 49d; K.H. Barnard, 1932: 217; Shoemaker, 1935: 240; Nicholls, 1938: 123; Pirlot, 1938: 329; J.L. Barnard, 1965: 470; J.L. Barnard, 1969c: 210, 204–206, fig. 83a, 84e, 84l, 85p; Bellan-Santini, 1972: 184: Arnaud, 1974: 546, 553, 556, tables 14, 17, 18; Bellan-Santini and Ledoyer, 1974: 649 [as form *kergueleni*]; Thurston, 1974: 18; Lowry and Bullock, 1976; 37–38; Holman and Watling, 1983: 221–223; Voss, 1988: 54; Wakabara et al., 1990: 2,4,6: Gonzalez, 1991: 53: Barnard and Karaman, 1991: 264, 267,271, figs. 51g, 52g, 53g; Debroyer and Jazdzewski, 1993: 33; Debroyer and Rauschert, 1999: 283; Debroyer et al., 2001: 747,748,750,751.

Material. 10 specimens, AM-P-25913, Otago Shelf, New Zealand, on sand and gravel, depth 65 meters, 30 October 1975, 45° 41'S 170° 55'E, coll. P.K. Roberts; 2 specimens, AM-P-25842, Otago Shelf, New Zealand, on sand and gravel, depth 75 meters, 6 March 1975, 45° 52'S 170° 53'E, coll. P.K. Roberts; 1 specimen, AM-P-34237, Davis Station, Antarctica, on rocks with some sand and silt, 90% macrophyte cover, depth 4 meters, 21

December 1981, det. J.K. Lowry; 1 specimen, AM-P-18384, Commonwealth Bay, Adelie Land, Australian Antarctic Territory, associated with algae, depth 46 meters, 3 April 1912, 67° 00'S 142° 36'E, det. G.E. Nicholls; 1 specimen, AM-E-48373, Sanders Point, Kangaroo Island, South Australia, depth 51 meters, 35°50'S 137°15'E, det. D.C. Chilton.

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head slightly shorter than pereonites 1 and 2 combined. Eye, one half the width of head; eye rounded oval; eye red. Rostrum absent. Antenna 1, subequal to antenna 2; peduncle segment 1 very small, one-third segment 2, or 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, equal to antenna 1; peduncle articles 4 and 5 equal; flagellum shorter than peduncle, with 10–11 segments. Mandible, spine row 3 on left, 2 on right; molars triturative and unequal in size; palp absent. Maxilla 1, inner plate apex rounded; with 1–2 terminal setae; outer plate with 10 spines, or 9 spines; palp long, not exceeding spine tips on outer plate; palp with several slender terminal spines. Maxilla 2, inner plate with sparse inner marginal setae. Maxilliped, palp segment 4 present; exceeding outer plate; length equal to width of palp segment 3; outer plate inner margin fringed with about 20 small spine teeth; outer plate reaching distal margin of palp segment 3; inner plate with plumed terminal setae.

Thoracic appendages. Gnathopod 1, coxa rounded below; basis anterior margin with several long setae and with sparse setae on posterior margin; carpus with long setae on posterior margin; carpus longer than propodus; propodus slender; propodus shorter than carpus; propodus anterior and posterior margins with long spines; males without deep notch on anterior margin; palm oblique, finely pectinate, or subequal to dactyl. Gnathopod 2, propodus shorter than carpus; palm relatively large, exceeding by dactyl.

Pereopods 3–7, carpus shorter than propodus; prehensile or parachelate. Pereopods 3 and 4, carpus shorter than propodus. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth. Pereopod 7, coxa similar in shape to coxa 5 and 6 but smaller; dactyl less than half length of carpus. Epimeral plate 2, acuminate; 3, posteroventral margin acuminate.

Abdominal appendages. Urosomite 1, dorsal margin low, not produced posteriorly. Urosomites 2 and 3, with greater than 3 dorsal spines. Uropod 1, inner ramus shorter than outer ramus. Uropod 3, outer ramus slightly shorter than inner. Telson, cleft at least 90 percent to base; lateral setation present; with several marginal spines; apical spines present.

Habitat. Associated with sponges and ascidians.

Distribution. Southern Ocean, Antarctica

Remarks: The nominate form of *Polycheria antarctica* requires redescription in order to establish a standard by which the other species and forms can be compared. The problem is defining the species in relation to all the forms. Thurston (1974b) proposed a solution by including *P. antarctica sensu lato* in his key to the forms, thereby considering *P. antarctica* an operation taxonomic unit, separable from the closely related "forms," as established by Schellenberg (1926; 1931). Much of the confusion in *Polycheria* taxonomy is the confusion of what defines this nominate species.

Holman and Watling (1983) suggested *Dexamine antarctica* Stebbing, 1875 as the type species of the genus, and in their synonymy, *Polycheria tenuipes* Haswell, 1879, *Tritaeta antarctica* (Stebbing, 1888), and *Tritaeta kergueleni* (Stebbing, 1888) are considered synonyms of *Polycheria antarctica.* They rejected the opinion of Chilton

(1912) that *Polycheria osborni* Calman, 1898, *Polycheria atolli* Walker, 1905, and *Polycheria obtusa* Thomson, 1882 should be synonomized with *P. antarctica.* In this report, *Polycheria antarctica* (Stebbing, 1875) is treated as a separate species to which several variant forms are attributed. Holman and Watling (1983) used several characters to supports is difference from the forms: (1) rounded head lobes in both sexes; (2) maxilla 1 palp 1-articulate, not broadened distally and extending to more than the tip of the spines of the outer plate; (3) maxilla 2, inner plate distally rounded with only a few setae on the inner margin; (4) Maxilliped outer plate extending no farther than the distal margin of palp article 4, and equal width of article 3; (5) margin of gnathopod 1 approximately equal to the dactyl. The material defined as *P. antarctica* in this report have those characters.

There are numerous reports in the literature of *Polycheria antarctica.* Many date from prior to Schellenberg (1931) when some of the variation in specimens, formerly attributed to very fluid understanding of *Polycheria antarctica*, could be assigned to one of the several forms. The application of the name *P. antarctica,* in areas distant from the Southern Ocean from where it was described, occur in the literature in the Caribbean Sea (Shoemaker, 1935), Red Sea, Arabian Sea, Indian Ocean and Indonesia (Barnard, 1965), and California and Mexico (Barnard, 1969a; 1969b). Reports from the Indian Ocean are considered to represent *P. atolli*, those from the East Pacific, *P. osborni,* those from Indonesia as, in part, a new species described herein (Species E), and the report of Shoemaker (1935) from the Virgin Islands as the new species.

The forms of *Polycheria antartica* are described an illustrated in this report. For comparison, figure 17 depicts coxal plates 1 and 4 of six forms of *Polycheria.*

Schellenberg (1931) divided the forms of *Polycheria antarctica* into two major groups. Group I has a rounded posteroventral margin of coxa 4, Group II has an acute posteroventral margin of coxa 4. Thurston (1974) followed this group division in the key to the forms.

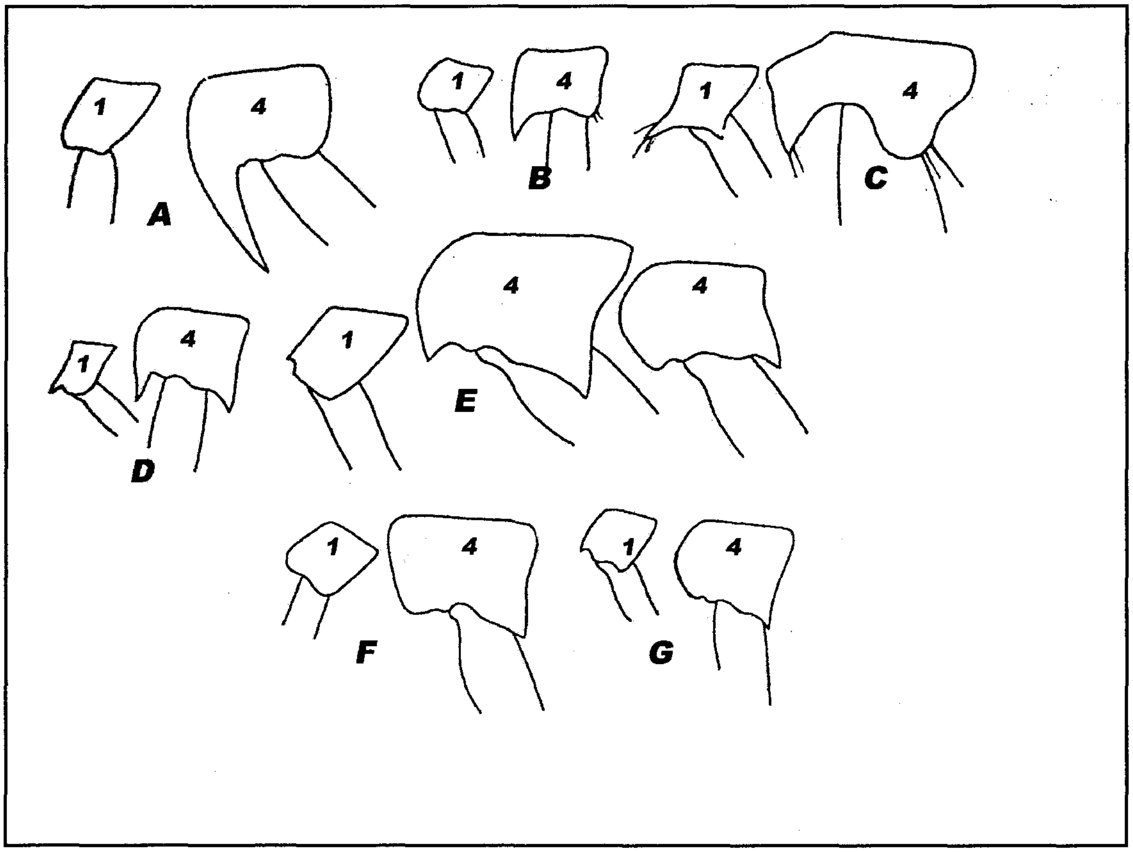

Figure 17 - Coxa of pereopods 1 and 4 for *Polycheria antartica* form *dentata*;
b, form *gracilipes*; c, form *similis*; d, form *bidens*; d, form *macrophthalma*, and f-g, *tenuipes*.
Adapted from Schellenberg, 1931.

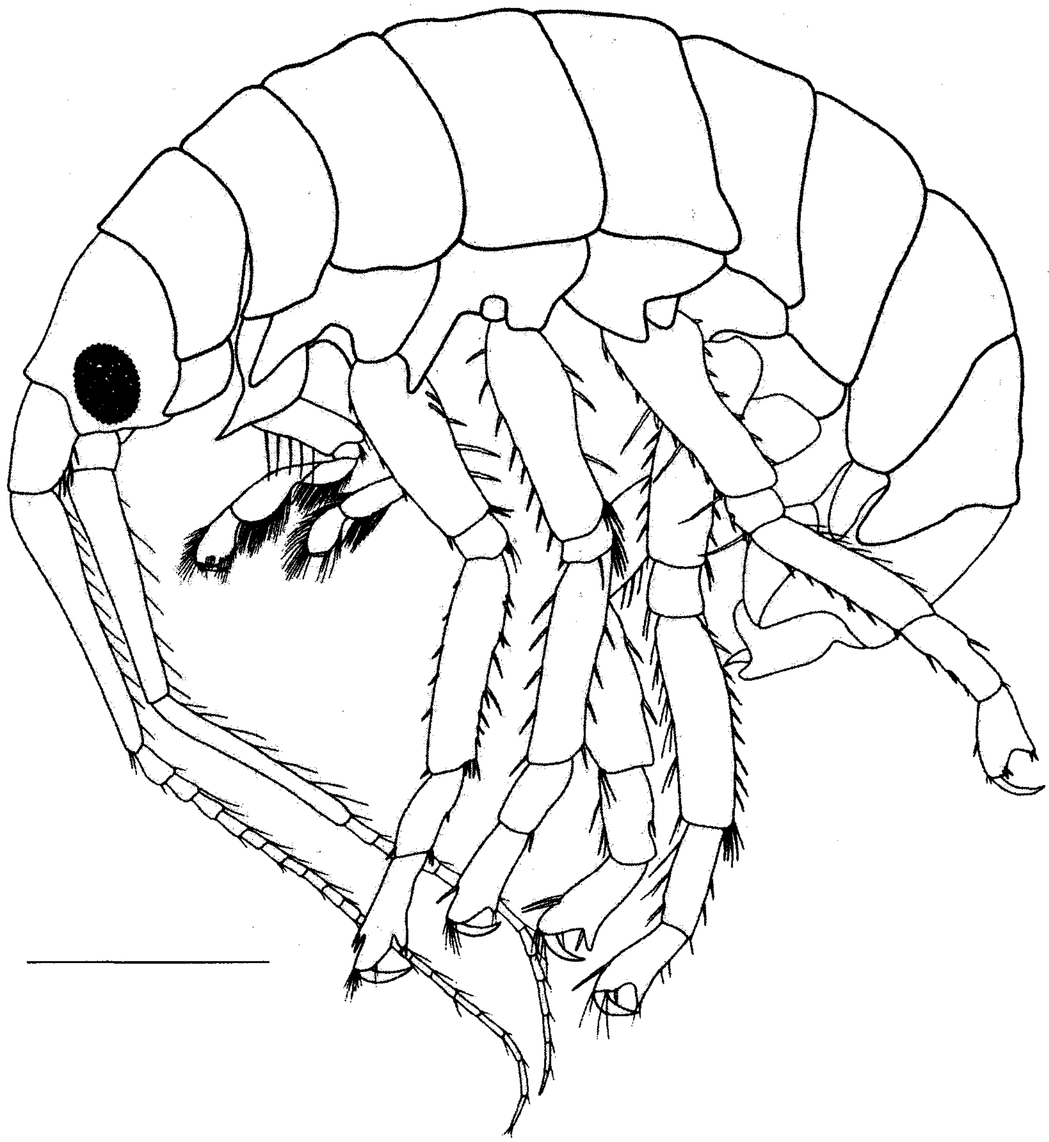

Figure 18 - *Polycheria antarctica* (Stebbing, 1875), from Barnard, 1969. Scale = 1.0 mm.

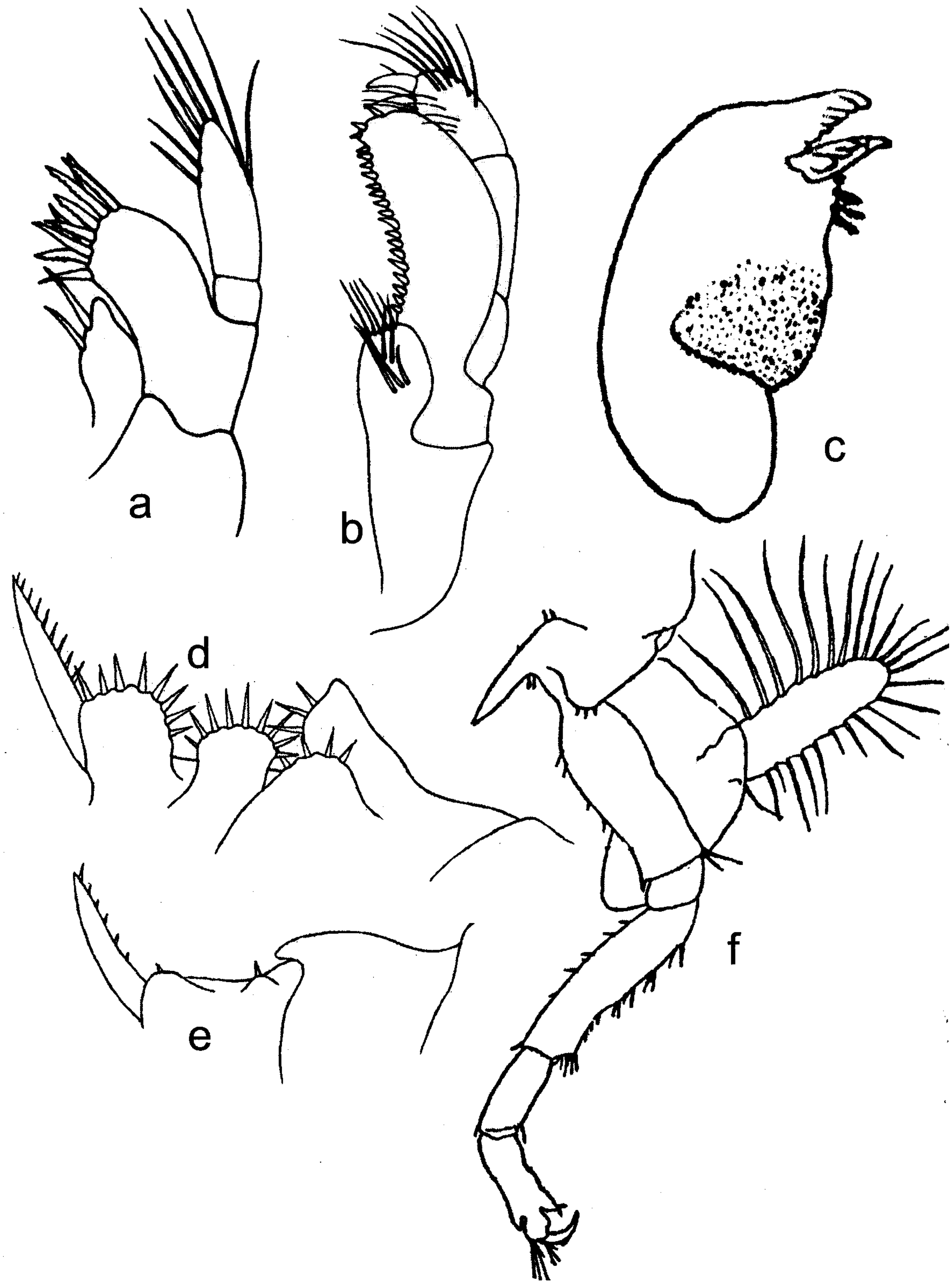

Figure 19 - *Polycheria antarctica* (Stebbing, 1875); a, maxilla 1; b, maxilliped; c, mandible; d, urosome (spinose phenotype); e, urosome (less spinose phenotype); f, pereopod 4. a and b from Barnard, 1969; d and e from Schellenberg, 1926; c and f from Stebbing, 1906.

Polycheria antarctica form *cristata* of Schellenberg

Figure 20-21

Synonyms. Polycheria antarctica form *cristata* - Schellenberg, 1926: 370, fig. 58a; Schellenberg, 1931: 215; Lowry and Bullock, 1976: 37–38; Thurston, 1974: 18; Truchot, 1974: 20; *Polycheria cristata* - Barnard and Karaman, 1991: 272; Debroyer and Jazdzewski, 1993: 33.

Material Examined. 1 ♂, 4.0 mm, 5 ♂♂, 3 ovigerous ♀♀, 1 ♂, 3.0 mm (on slides), MNB 7990, Kerguelen Island, South Indian Ocean, 109 m; 1 terminal ♂, 5.4 mm, MNB 20-431, Kerguelen Island, South Indian Ocean.

Type locality. Kerguelen Island, South Indian Ocean.

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–2 combined. Eye, less than half width of head; eye round; eye brownish black in alcohol. Rostrum absent. Antenna 1, subequal to antenna 2; peduncle segment 1 short and stout, segment 2 less stout; flagellum with 10–20 articles. Antenna 2, longer than antenna 1 in male; peduncle articles 4 and 5 equal; flagellum shorter than peduncle, with 10–11 segments. Mandible, spine row 2–3; molars triturative; palp absent. Maxilla 1, inner plate apex rounded; with 1–2 terminal setae; outer plate truncate terminally; outer plate with 9 spines; palp long, not exceeding spine tips on outer plate; palp sublinear, tapered distally; palp with 3 terminal plumed setae. Maxilla 2, inner plate subequal to outer plate; with 3 terminal and 2 lateral setae; outer plate with 6–7 stiff setae terminally. Maxilliped, palp segment 4 present; exceeding outer plate; length less than width of segment 3; outer plate inner margin with 6–9 spines; inner plate one-third length of outer plate; outer plate reaching middle of palp segment 3; inner plate with 1–2 spines.

Thoracic appendages. Gnathopod 1, coxa rounded below; coxa, not produced anteroventrally, distally rounded; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis without marginal setae or spines; carpus posterior margin slightly produced and heavily setose; carpus longer than propodus; propodus short and deep, width 60% of length; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm oblique, finely pectinate; dactyl exceeding palm, broadly curved. Gnathopod 2, coxa anteroventral margin not produced forward, distally rounded; basis subequal to basis of gnathopod1; merus greater than length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus 2 to 2.5 times longer than wide; palm relatively large, exceeding by dactyl; palm transverse; dactyl falcate, with long proximal outer seta. Pereopods 3–7, basis broader than distal segments; prehensile or parachelate; propodus not widened distally; coxal gills weakly pleated. Pereopods 5–7, coxae broad, length more than twice width. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa less than three times its basal width; basis posterior margin with sparse setae; merus longer than propodus; merus with 1 posterodistal spine and with 1 posterior marginal spine and 1 posterodistal spine; carpus half length of propodus; carpus with 1 long posterodistal spine; propodus with anterodistal setae. Pereopod 4, anteroventral angle of coxa produced to form sharp tooth; posteroventral angle of coxa rounded; merus longer than propodus. Pereopod 5, coxa, anteroventral lobe deepest; basis longer than merus without posterior lobe at base; merus shorter than carpus and propodus combined; carpus subequal to propodus. Pereopod 6, coxa with small, rounded anteroventral lobe;

basis longer than merus; merus with posterodistal setae; carpus with anterodistal and posterodistal spines; propodus with 2–3 anteromarginal spines. Pereopod 7, coxa rounded posteriorly; basis posterodistal setae and linear; merus shorter than basis; merus with a strong anterodistal spine; carpus with anterodistal and posterodistal spines and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus with 2–3 anterior spines and palm with short, strong distomedial spine. Epimeral plate 1, tapered distally; 2, evenly rounded distally with 2 ventral marginal spines; 3, posteroventral margin posterodistally rounded; 3, ventral margin with 2 strong curved spines.

Abdominal appendages. Urosomite 1, dorsal margin extended posteriorly to mask part of urosomite 2–3, or strongly produced posteriorly to form blunt process. Urosomites 2–3, distal and proximal prominences with 2–3 dorsal spines and fused with a mid-dorsal saddle-shaped indentation; urosomite 2–3, dorsolateral margins rounded. Uropod 1, shorter than uropod 3; peduncle with several long setae on distal margin; inner ramus subequal to peduncle; rami inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; inner ramus longer than outer ramus; outer ramus shorter than inner; rami with long apical spines. Uropod 3, peduncle one fourth length of inner ramus; without spines; rami wide proximally, tapering to apices; outer ramus, outer margin spinose; inner ramus twice length of peduncle; longer than uropod 1 and telson; outer ramus shorter than inner. Telson, broadest medially; half as broad as long; cleft about 80 percent to base; attaining middle of uropod 3; with 2–3 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Unknown

Distribution. Kerguelen Island, South Indian Ocean

Remarks. The morphological characters of *P. antarctica* f. *cristata* are described in detail in this report, however, nothing is known of its habitat. Schellenberg (1926) described it briefly in a report of the Amphipoda of the German South Polar Expedition (1901-1903) and mentioned it again in the 1931 report on the Swedish expedition to the Magellanic region of South America and the South Georgia Island region near the Antarctica Peninsula, however, neither report provided host or habitat information and the species has not been reported since outside the Kerguelen Islands.

P. antarctica f. *cristata* falls into Schellenberg's Group I where in posteroventral angle of coxa 4 is rounded. This form characterized has by a produced and very spinose urosomite 2-3.

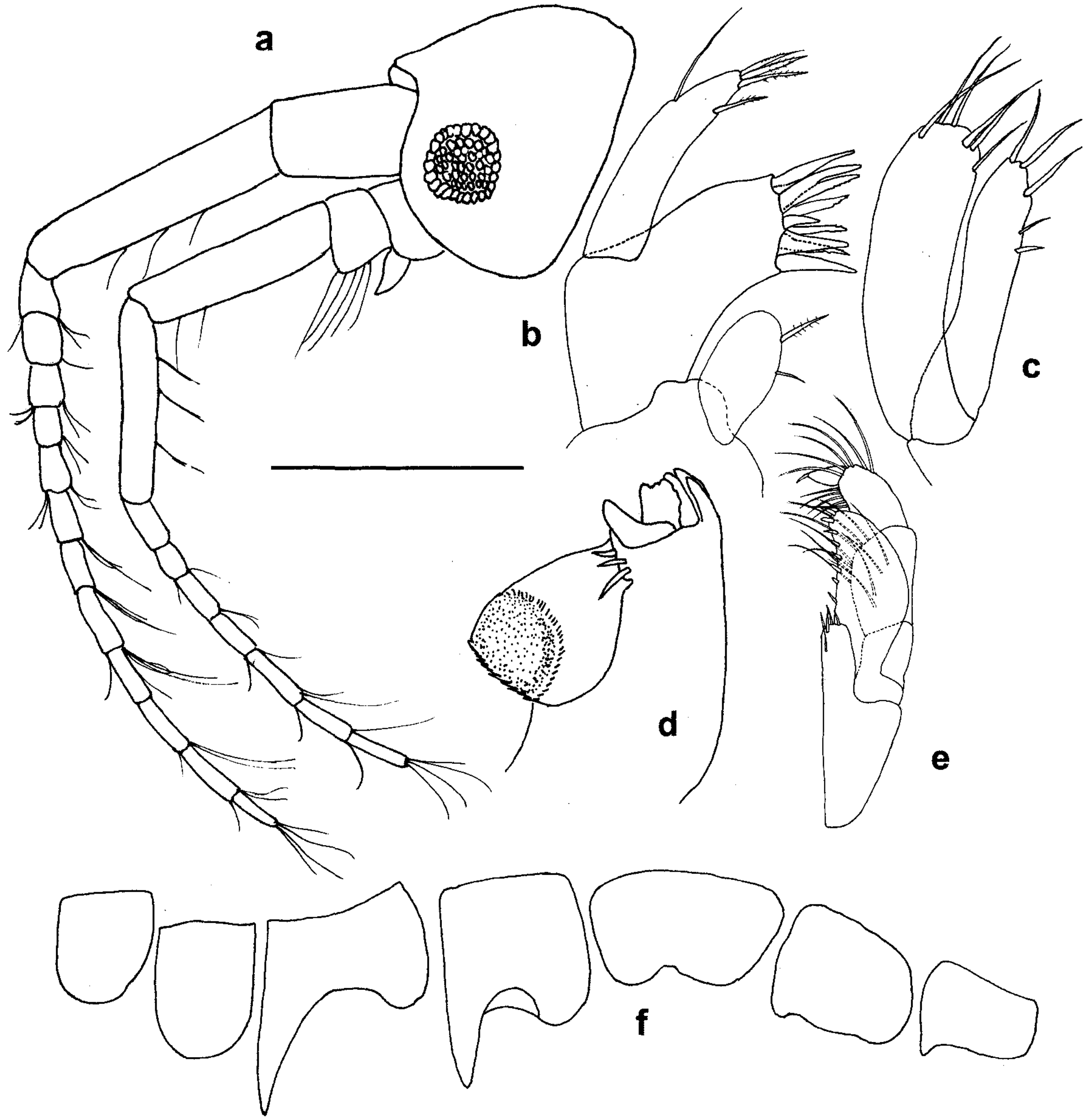

Figure 20 - *Polycheria f cristata* Schellenberg, 1926. ♀, 4.0 mm, MNB 7990, Kerguelen Island; b, maxilla 1; c, maxilla 2; d, mandible; e, maxilliped; ♂, 3.0 mm, MNB 7990, Kerguelen Island; a, head and antenna 1-2; f, coxal plates 1-7 (left to right). Scale = 0.5 mm – a.

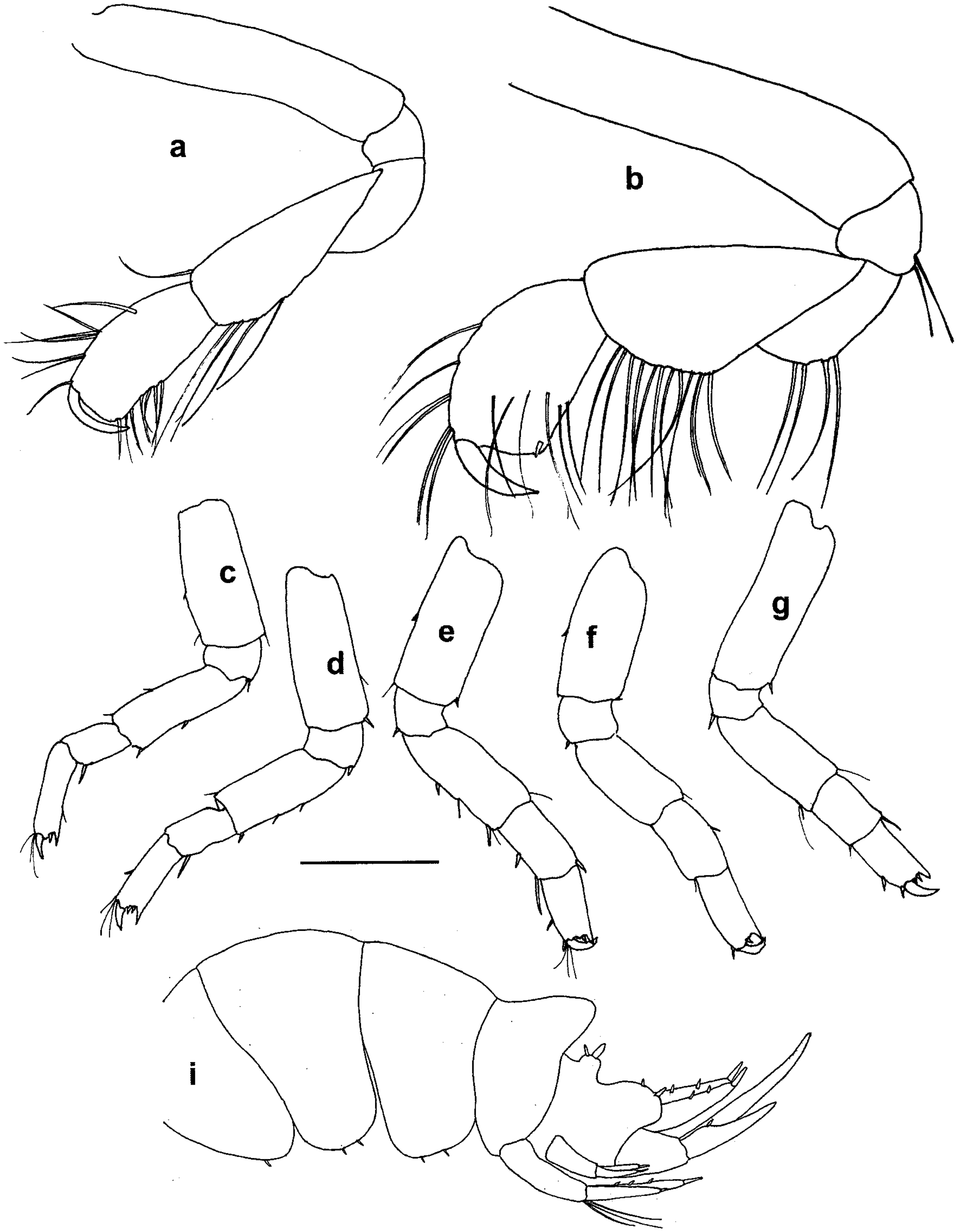

Figure 21 – *Polycheria antarctica* f. *cristata* Schellenberg, 1926. X, 3.0 mm, MNB 7990, Kerguelen Island; a, gnathopod 1; b, gnathopod 2; c – g, pereopods 1-7; i, pleosome and urosome. Scale = 0.5 mm – c-g.

Polycheria antarctica form *dentata* of Schellenberg

Figure 22-23

Synonyms. Polycheria antarctica form *dentata* - Schellenberg, 1931: 217, fig. 107a, 109; K.H. Barnard, 1932: 217; Thurston, 1974a: 90; Thurston, 1974b: 18; Lowry and Bullock, 1976: 37–38; Holman and Watling, 1983: 223–224, fig. 7; *Polycheria dentata* - Barnard and Karaman, 1991: 220; Bousfield and Kendall, 1994: 48, fig. 25–2.

Material Examined. 1 ♀, 4.5 mm, South Georgia Island, (illustrated); 1 ♂, South Georgia Island, Grytviken, 51° 30'S 36° 30'W, 24 May 1902, MNB 22908, 30 m, gravel with algae, det. A. Schellenberg; 1 ♂ 6.3 mm, 11 ♂♂ 13 ♀♀ 18 juveniles, *Eltanin* Cruise 6, Station 410-31, 31 December 1962, 220-240 meters (USNM); 1 ovigerous. ♀, 5 ♂♂, 17 juveniles, *Isla Orcades* Cruise 575, Station 90, 54°50.6'S 37°28.3'W, 7 June 1975, 223 – 227 m. (USNM).

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–2 combined. Eye, one-third height of head; eye round; eye brownish black in alcohol. Rostrum minute. Antenna 1, longer than half length of body; peduncle segment 1 short and stout, segment 2 less stout and 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, longer than antenna 1 in male; peduncle article 5 shorter than 4; flagellum longer than peduncle. Mandible, palp absent. Maxilla 1, inner plate with one terminal seta. Maxilliped, palp segment 4 present; outer plate inner margin with 6–9 spines.

Thoracic appendages. Gnathopod 1, coxa, distally rounded, wider than deep; basis sublinear, equal to ischium, merus, carpus, and propodus combined; carpus with facial and posteromarginal setae and posterior margin slightly produced and heavily setose;

carpus longer than propodus; propodus narrowed at base; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; palm oblique, finely pectinate and shorter than dactyl; dactyl bifid distally and exceeding palm, broadly curved. Gnathopod 2, coxa subrectangular with distal angles rounded; basis with posteromarginal setae; merus less than half length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus oblong, three times as long as broad; palm relatively large, exceeding by dactyl; palm with a slender spine at palmar angle and distinct, oblique; dactyl bifid distally. Pereopods 3–7, basis broader than distal segments; prehensile or parachelate; propodus widened distally; coxal gills weakly pleated. Pereopods 3 and 4, carpus longer than propodus. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa three times or greater its basal width; posteroventral margin of coxa rounded; basis with anterodistal and posterodistal spines and posterior margin with sparse setae; merus longer than carpus and propodus combined; merus with 1 posterodistal spine, with 1 long anteromarginal spine and 1 large posterodistal spine, and with several large posteromarginal spines and posterodistal spines; carpus longer than propodus; carpus posterodistal and anterodistal margins with short spines; propodus with 2 anterodistal spines, with anterodistal setae, and with 1 large curved spine at posterodistal projection; palm of propodus with 1 medial spine and deeply recessed, subtriangular. Pereopod 4, anteroventral angle of coxa produced to form long sharp tooth three times its basal width; posteroventral angle of coxa rounded; Pereopod 4, basis with anteromarginal spines and setae, or with posteromarginal spines; merus longer than carpus and propodus combined; merus with 1 long anteromarginal spine, with several large posteromarginal spines, and with 1 posterodistal spine. Pereopod 5, coxa, anteroventral lobe deepest and with a strong anteroventral process; basis subequal to merus with weak posterior lobe near base; merus shorter than carpus and propodus combined; carpus longer than propodus. Pereopod 6, coxa with a triangular tooth anteriorly and ventral angles rounded; basis longer than merus; merus with 1 posterodistal spine and with 3–4 anterior marginal spines; carpus with 1 posterodistal spine and with 1 medial and 1 distal anteromarginal spines; propodus with 2 anterodistal spines, with 1 large curved spine at posterodistal projection, and with anterodistal setae. Pereopod 7, coxa posteroventral margin produced into blunt lobe and anteroventral angle rounded; basis with 2–3 small posteromarginal spines and linear; merus shorter than basis; merus with 2 long marginal spines, or with a strong anterodistal spine; carpus with anterodistal and posterodistal spines and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus produced posterodistally with 1 long curved spine, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; 2, acuminate and ventral margin with 2–3 short, curved spines; epimera 2 and 3, anteroventral margin without setae; 3, posteroventral margin with a large triangular tooth; 3, ventral margin with 4 short spines.

Abdominal appendages. Urosomite 1, dorsal margin extended posteriorly to mask part of urosomite 2–3 and dorsal keel with acute posterior process. Urosomites 2–3, fused, with lateral ridges produced posteriorly into lobes; 2 and 3, dorsal margins of lobes with a proximal and distal spine. Uropod 1, shorter than uropod 3; peduncle with several long setae on distal margin; inner ramus shorter than outer ramus; peduncle subequal to inner ramus; rami with apical spines, outer ramus with dorsolateral spines, and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle shorter than rami with a strong distomedial spine; inner ramus longer than peduncle; outer ramus subequal to inner ramus; rami with long apical spines. Uropod 3, peduncle one half length of inner ramus; with a short, distal spine on dorsal margin; outer ramus with 4 dorsolateral spines; inner ramus exceeding the length of the telson and subequal to outer ramus; longer than uropod 1 and telson; outer ramus two thirds length of inner ramus. Telson, broadest proximally; width two-thirds length; cleft about 80 percent to base; attaining middle of uropod 3; lateral setation absent; with no lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Among gravel with algae; clay and stones.

Depth occurrence. 30–1120 m.

Remarks. *Polycheria antarctica* f. *dentata* was reported from the South Shetland Islands area by Holman and Watling (1983), based on the cruises of two American research ship R/V *Islas Orcadas* and R/V *Eltanin.* These reports increased the known depth range of this form of *Polycheria* to 1120 m. Schellenberg (1931) described the form based on material from South Georgia Island from depths of 30-312 m. The shallow specimens were found among algae and gravel while the deeper specimens were collected with stones and clay. *Polycheria antarctica* f. *dentata* is characterized by an acute dorsal keel on urosomite 1 and by the dorsolateral teeth on urosomites 2-3. The posteroventral angle of epimeral plate 3 has a very pronounced tooth, possibly the largest such tooth known for the genus.

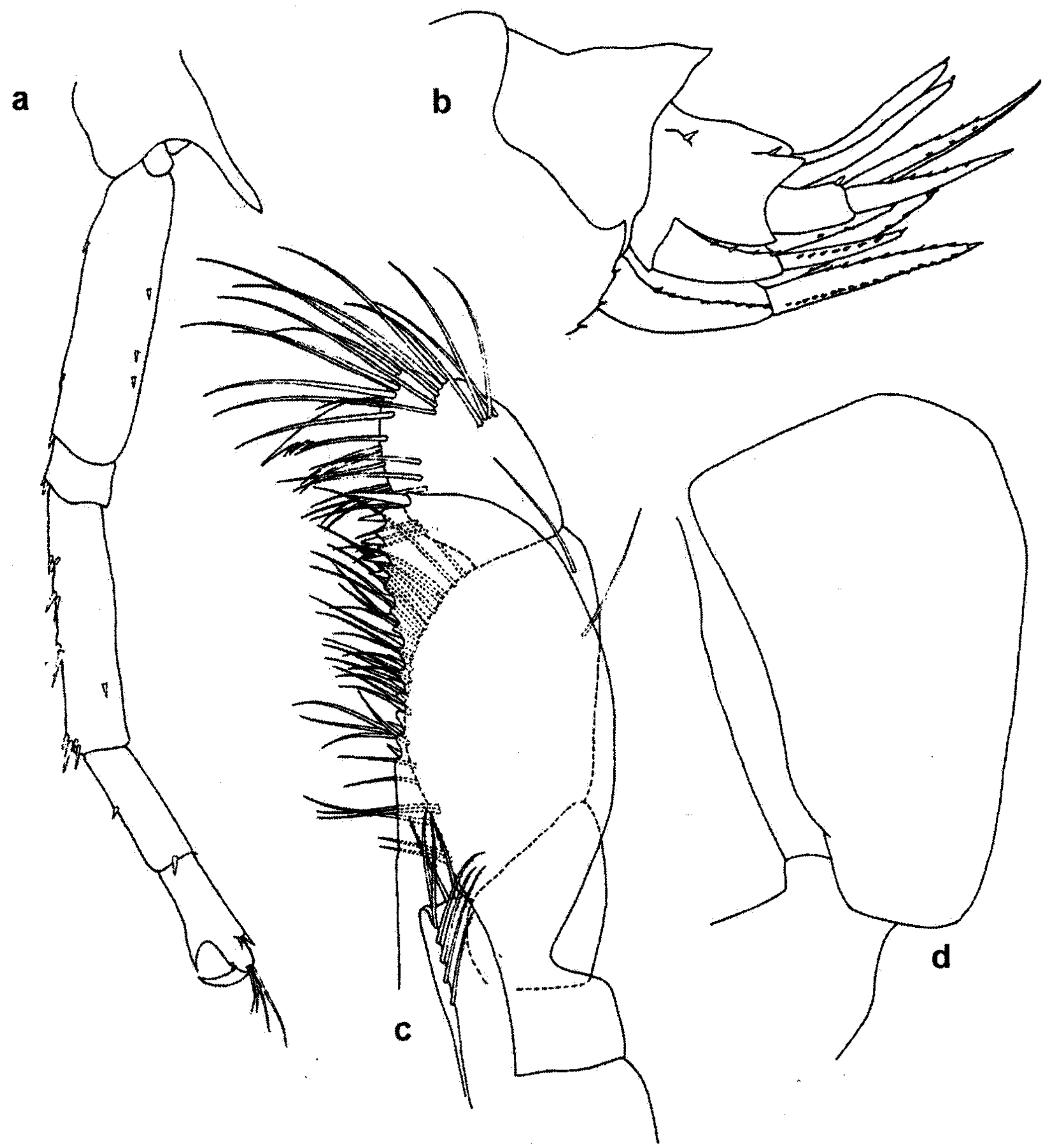

Figure 22 - *Polycheria antarctica* form *dentata* Schellenberg, 1931. Modified from Holman and Watling, 1983. a, pereopod 3; b, urosome and posterior margin of epimeral plate 3; c, maxilliped; d, coxa 1.

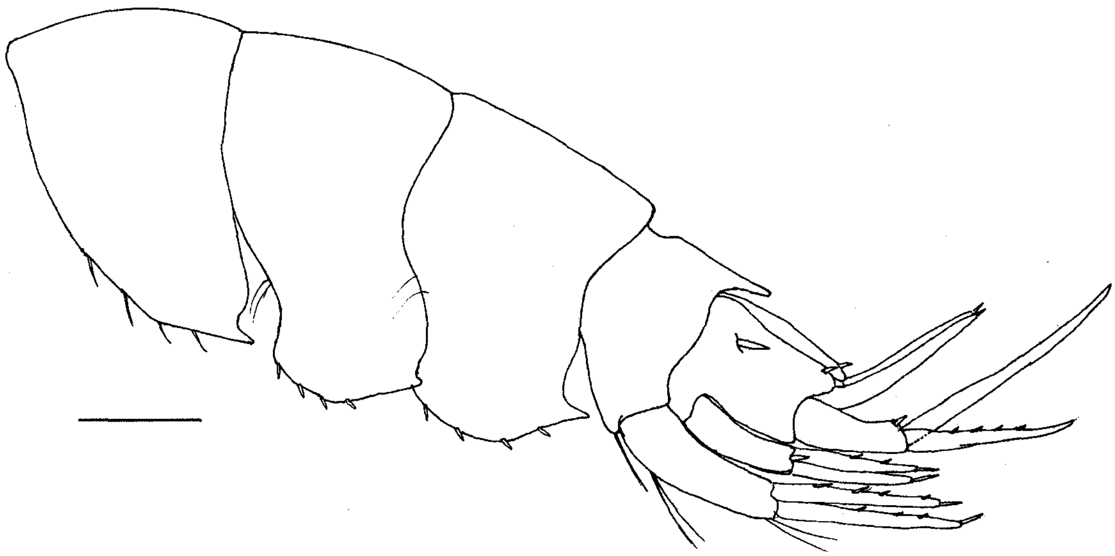

Figure 23 – *Polycheria antarctica* form *dentata* Schellenberg, 1931. ♀, 4.5 mm, South Georgia Island, MNB 22-908; pleosome and urosome. Scale = 0.5 mm.

Polycheria antarctica form *gracilipes* of Schellenberg

Figure 24

Synonyms. Polycheria antarctica form *gracilipes* - Schellenberg, 1931: 216, fig. 107b, 108g; Thurston, 1974a: 90, fig. 35 j-k; Thurston, 1974b: 18: Lowry and Bullock, 1976: 37–38; Holman and Watling, 1983: 224, fig. 8; *Polycheria cristata* - Barnard and Karaman, 1991: 220; Debroyer and Jazdzewski, 1993; Bousfield and Kendall, 1994: 48, fig. 25–3, part 1,2, and 3.

Material Examined. 1 ovigerous ♀, 6 mm, 30 May 1902, Grytviken, 22 m, among stones and algae; 1 ♀, 6 mm, 3 juveniles, 2-5 mm, 5 June 1902, mouth of Cumberland Bay, 210-310 m, with gray stones, MNB 22 907, South Georgia Island, approximately 54° 18'S 36° 25'W.

Type locality. South Georgia Island, Cumberland Bay.

Description. Head appendages. Head, anteroventral margin forming a right angle the anterior margin, occasionally slightly produced; head slightly shorter than pereonites 1 and 2 combined. Eye, less than half width of head; eye rounded oval; eye light brown in alcohol. Rostrum minute. Antenna 1, longer than half length of body; peduncle segment 1 short and stout, segment 2 less stout and 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, shorter than antenna 1; peduncle article 5 shorter than 4; flagellum shorter than peduncle, with 10–11 segments. Mandible, palp absent. Maxilla 1, inner plate apex acuminate; outer plate truncate terminally; outer plate with 9 spines; palp longer than outer plate; palp sublinear, tapered distally; palp with 5–6 terminal and subterminal setae. Maxilla 2, inner plate subequal to outer plate; with 6–7 terminal and outer marginal stiff setae; outer plate with 6–7 stiff setae terminally. Maxilliped, palp segment 4 present; exceeding outer plate; length equal to width of palp segment 3; outer plate inner margin with 6–9 spines; inner plate one-third length of outer plate; outer plate reaching distal margin of palp segment 3; inner plate with plumed terminal setae.

Thoracic appendages. Gnathopod 1, coxa, not produced anteroventrally, distally rounded; basis sublinear, equal to merus, carpus, and propodus combined and widened distally; basis anteromedial margin with 3 long simple setae; carpus with facial and posteromarginal setae; carpus longer than propodus; propodus twice as long as wide and narrowed at base; propodus shorter than carpus; propodus with heavy facial setae; males (notch) without deep notch on anterior margin; palm convex and shorter than dactyl; dactyl exceeding palm, broadly curved. Gnathopod 2, coxa subrectangular with distal angles rounded; basis subequal to basis of gnathopod1; merus less than half length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus half as wide as long; palm relatively large, exceeding by dactyl; palm distinct, oblique. Pereopods 3–7, prehensile or parachelate; coxal gills weakly pleated. Pereopods 3 and 4, carpus shorter than propodus. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa short, twice as long as its basal width; posteroventral margin of coxa rounded; basis with anterodistal and posterodistal spines; merus subequal to propodus; merus with 1 posterodistal spine, with 2 large posteromarginal spines, and with anterodistal seta; carpus slightly shorter than propodus; carpus posterodistal and anterodistal margins with short spines; propodus with anterodistal setae, with 1 large curved spine at posterodistal projection, and with 1 short distomedial (palmar) spine; palm of propodus deeply recessed, subtriangular. Pereopod 4, anteroventral angle of coxa produced to form sharp tooth; posteroventral angle of coxa rounded; Pereopod 4, basis with 1 posterodistal spine; merus subequal to propodus; merus with 1 posterodistal spine and with 2 posteromarginal spines. Pereopod 5, coxa, posterior margin rounded and with a strong anteroventral process; basis longer than merus without posterior lobe at base; basis with 2–3 anterodistal spines and with 3 anteromarginal spines; merus shorter than carpus and propodus combined; merus with 1 posterodistal spine and with 2 posteromarginal spines; carpus longer than propodus; carpus with 2 strong posterodistal spines, with 1 long anteromarginal spine, and with 2 posteromarginal spines; propodus palm with a short, thick medial spine, with a large curved posterodistal spine, and with 1 anteromarginal spine. Pereopod 6, coxa with a triangular tooth anteriorly and ventral angles rounded; basis with a posterior proximal knob; basis with 1 posterodistal subdistal spine; merus with posterodistal spines, with 3 short anterior marginal spines and 3 long stiff setae, and with anterodistal spines; carpus with anterodistal and posterodistal spines; propodus palm with short, thick medial spine, with 2 anterodistal spines, with 2–3 anteromarginal spines, and with 1 large curved spine at posterodistal projection. Pereopod 7, coxa posteroventral angle produced, acute and anteroventral margin produced, bluntly rounded; basis with 4 posteromarginal spines and weakly expanded proximally; merus shorter than basis; merus with 2–3 long anterodistal and posterodistal spines and with a strong posterodistal spine; carpus with 3 strong anteromarginal spines; dactyl less than half length of carpus; propodus produced posterodistally with 1 long curved spine, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, posteroventral angle with a small, triangular tooth; 2, acuminate and ventral margin with 2–3 short, curved spines; epimera 2 and 3, anterior margins with a few short setae; 3, posteroventral margin acuminate; 3, ventral margin with 4 short spines.

Abdominal appendages. Urosomite 1, dorsal margin with a proximal saddle-shaped concavity and smoothly rounded. Urosomites 2–3, fused, with lateral ridges produced posteriorly into lobes; 2 and 3, dorsal margins of lobes with a proximal and distal spine; urosomite 2–3, dorsolateral margins with rounded lobes. Uropod 1, shorter than uropod 3; peduncle with a long posterodistal spine one quarter length of peduncle and lacking marginal setae; peduncle equal to outer ramus, longer than inner ramus; rami without marginal spines. Uropod 2, peduncle slightly longer than rami with 1–4 outer marginal spines; inner ramus subequal to peduncle; outer ramus shorter than inner; rami with long apical spines. Uropod 3, peduncle shorter than rami; with 2 distal spines; rami wide proximally, tapering to apices; inner ramus with 4 dorsolateral spines and outer ramus with 4 dorsolateral spines; inner ramus exceeding the length of the telson and three times as long as peduncle; inner ramus greater than twice the length of peduncle; outer ramus two thirds length of inner ramus. Telson, broadest proximally; width one third length; cleft at least 90 percent to base; equal to rami of uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines long, one quarter length of telson.

Habitat. Among sponges and algae. Thurston (1974) reported its occurrence with the *Iophon-Phyllophora* (sponge-algae) association at the South Orkney Islands.

Depth occurrence. 22–310 m.

Distribution. South Georgia Island, Orkney Islands, South Ocean.

Remarks. Holman and Watling (1983) reported that *Polycheria antarctica* form *gracilipes* differs from forms *dentata, acanthopoda,* and *nudus* by three major characters: the relative lengths of the merus and propodus on pereopods 3 and 4, the spination on the inner margin of maxilliped outer plate, and the length of uropod 1. Examination of the specimens listed above confirms these morphological differences with the listed forms, supporting the conclusions of Holman and Watling (1983). Thurston (1974) indicated the presence of a persistent anteroventral cephalic lobe in adult females and juveniles. The material examined for this report was part of that examined by Schellenberg (1931); the adult male possessed a quadrate, occasionally produced, anteroventral margin of the head. This character was not mentioned among those used by Holman and Watling (1983) to separate *P. antarctica* f. *gracilipes* from the other forms and species of the genus.

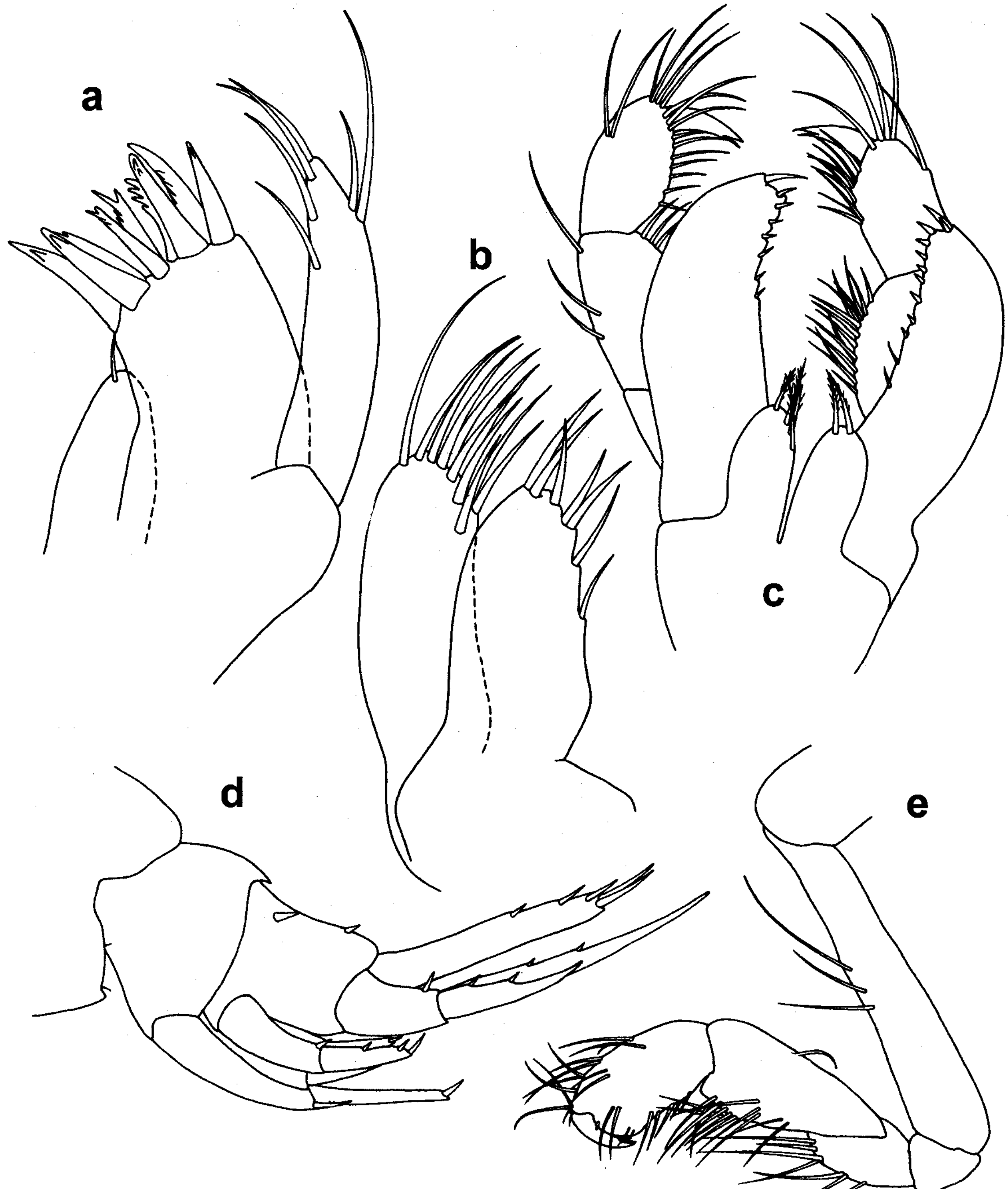

Figure 24 – *Polycheria antarctica* form *gracilipes* Schellenberg, 1931. immature ♀, 3.5 mm, South Georgia Island. Modified from Holman and Watling, 1983. a, maxilla 1; b, maxilla 2; c, maxilliped; d, urosome; e, gnathopod 1.

Polycheria antarctica form *intermedia* of Stephensen

Figure 25

Synonyms. Polycheria antarctica form *intermedia* Stephensen, 1947: 66, fig. 21; Thurston, 1974b: 18; Lowry and Bullock, 1976: 37–38; *Polycheria intermedia.* - Barnard and Karaman, 1991: 272; Debroyer and Jazdzewski, 1993: 34.

Materials. None available. Description from Stephenson, 1947

Type locality. Kerguelen Island, South Indian Ocean.

Description. Head appendages. Antenna 1, subequal to antenna 2; peduncle segment 1 shorter than segment 2. Antenna 2, equal to antenna 1; peduncle articles 4 and 5 equal. Mandible, palp absent. Maxilla 1, inner plate broad and apex rounded; with 1–2 terminal setae; outer plate with 8 spines. Maxilliped, palp segment 4 present.

Thoracic appendages. Gnathopod 1, coxa, not produced anteroventrally, distally rounded; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anterior margin with several long setae; carpus with long setae on posterior margin; carpus longer than propodus; propodus short and deep, width 60% of length; propodus shorter than carpus; males without deep notch on anterior margin. Gnathopod 2, coxa anteroventral margin not produced forward, distally rounded; basis with posterodistal setae and subequal to basis of gnathopod1; propodus shorter than carpus; propodus 2 to 2.5 times longer than wide. Pereopods 3–7, basis length 3 to 4 times width; prehensile or parachelate. Pereopods 5–7, coxae each with a short process at the mid-ventral margin. Pereopod 3, anteroventral margin of coxa produced anteriorly into sharp tooth; process of coxa three times or greater its basal width; basis with anterodistal and posterodistal spines; merus equal to carpus and propodus combined; carpus slightly shorter than propodus. Pereopod 4, anteroventral angle of coxa produced to form long sharp tooth three times its basal width; posteroventral angle of coxa rounded. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis longer than merus without posterior lobe at base; merus shorter than carpus and propodus combined. Pereopod 6, coxa shaped like coxa 5, but smaller; basis subequal to merus. Pereopod 7, coxa similar in shape to coxa 5 and 6 but smaller; pereopods 5 and 7, carpus subequal to propodus; basis linear; dactyl less than half length of carpus. Epimeral plate 1, posteroventral corner evenly rounded; 2, squarish; 3, posteroventral margin squared.

Abdominal appendages. Urosomite 1, dorsal margin with strong triangular tooth. Urosomites 2–3, each with a projecting lobe with 2–3 dorsal spines, with mid-dorsal saddle-shaped indention. Uropod 1, subequal to uropod 3; peduncle with several long setae on distal margin. Uropod 3, peduncle one fourth length of inner ramus; outer margin of outer ramus with 1–3 short spines; inner ramus longer than outer ramus; exceeding telson; outer ramus shorter than inner. Telson, attaining middle of uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Unknown

Distribution. Kerguelen Island, Southern Indian Ocean

Remarks. Stephensen (1947) described the new form *Polycheria antarctica* form *intermedia* from Kerguelen Island where previously *P. antarctica* form *cristata* Schellenberg, 1926 and *P. antarctica* form *kergueleni* (Stebbing, 1875) had been described. In comparing *P. antarctica* f. *intermedia* with the other two Kerguelen Island forms, he stated "regarding the dorsal armature of urosome (sic) they take an intermediate position between the two forms listed above." (Stephensen, 1947: 67). The rounded posteroventral margin of coxa 4 places *P. antarctica* form *intermedia* into Group I of Schellenberg (1931), along with the other two Kerguelen Island forms. The urosome shape and armature fall intermediately between the previously described forms, thus its specific name. *P. antarctica* f. *intermedia* has not been recorded in the either ecological or taxonomic literature since its description, with the exception of its inclusion in the key to the forms by Thurston (1974).

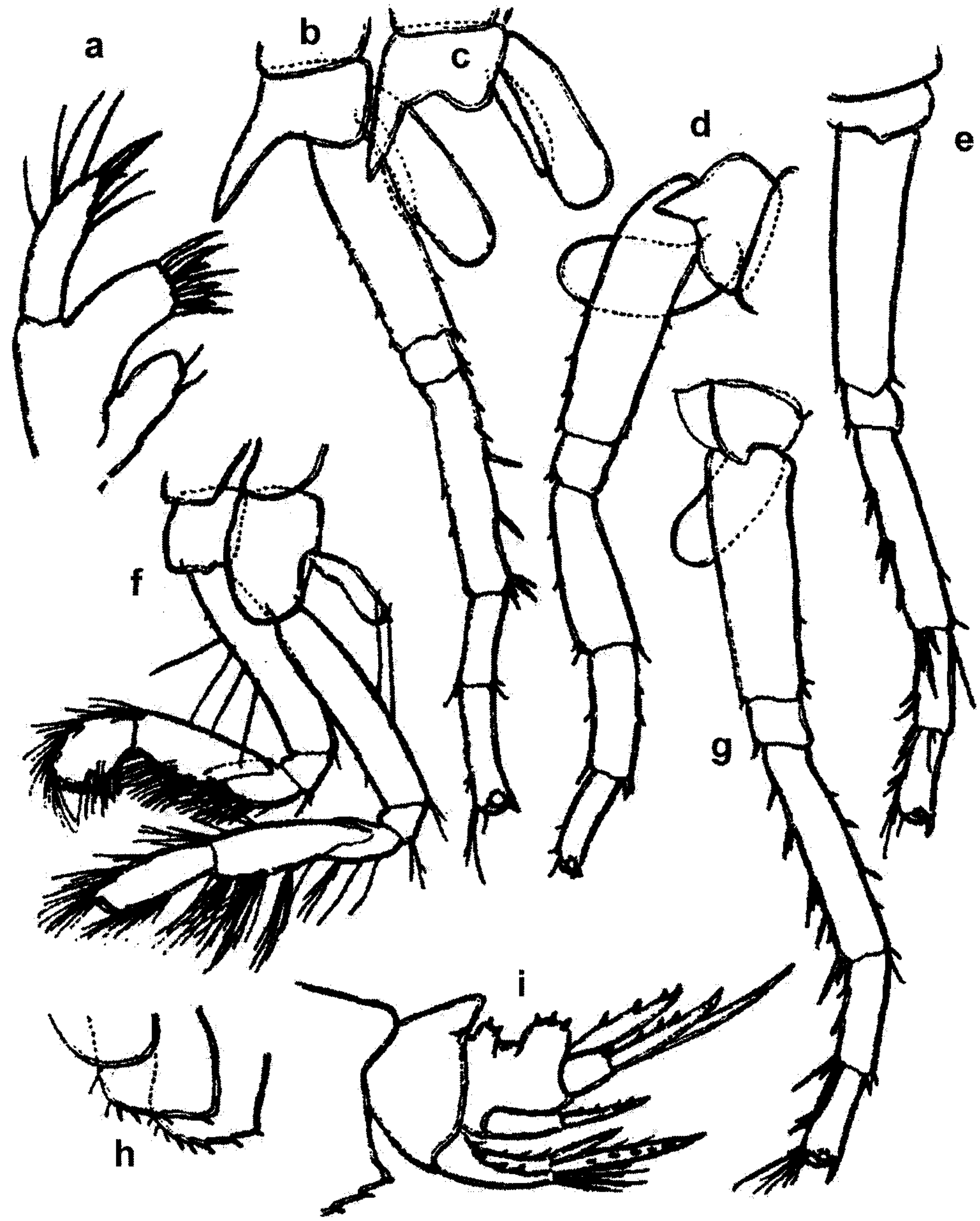

Figure 25 - *Polycheria antarctica* form *intermedia* Stephenson, 1947. Modified from Stephenson, 1947. ♀ juvenile, Kerguelen Island. a, maxilla 1; b, pereopod 3; c, coxal plate 4; d, pereopod 5; e, pereopod 7; g, gnathopods 1-2; h, epimeral plates 1-3; i, urosome.

Polycheria antarctica form *kergueleni* of Schellenberg

Figure 26

Synonyms. *Tritaeta kergueleni* Stebbing, 1988: 941, pl. 88 Schellenberg, 1931: 215; *Polycheria antarctica* form *kergueleni*. - Thurston, 1974a: 18; Bellan-Santini and Ledoyer, 1974: 649; Lowry and Bullock, 1976: 37–38; Holman and Watling, 1983: 224; *Polycheria kergueleni*. - Barnard and Karaman, 1991: 272; Debroyer and Jazdzewski, 1993: 34.

Materials. 2 ♀♀ 4.0 mm, 5.0 mm, 1 ♂ 4.8 mm, 1 ovigerous ♀ 4.0 mm, MNB 20-439, Observant Bay, Kerguelen Island, South Indian Ocean, 49° 25.15'S 69° 53.63'E; 2 ♂♂, 4 ♀♀, MNB 20-011, Observant Bay, Kerguelen Island, South Indian Ocean, 49° 25.15'S 69° 53.63'E.

Type locality. Royal Sound, Kerguelen Islands, South Atlantic Ocean, *Challenge*r Station 149D, 98 m, volcanic mud, 29 January 1874. The original material is located at the British Museum of Natural History.

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head slightly shorter than pereonites 1 and 2 combined. Eye, greater than one-half width of head; eye rounded oval; eye brownish black in alcohol. Rostrum minute. Antenna 1, subequal to antenna 2; peduncle segment 1 shorter than segment 2; flagellum 21–25 articles. Antenna 2, longer than antenna 1 in male and equal to antenna 1; peduncle articles 4 and 5 equal; flagellum shorter than peduncle, with 10–11 segments. Mandible, spine row 3 on left, 2 on right; molars subequal in size; palp absent. Maxilla 1, inner plate apex rounded; with 2–3 terminal setae; outer plate truncate terminally; outer plate with 9 spines; palp longer than outer plate; palp truncate distally; palp with 5–6 terminal and subterminal setae.

Lower lip, outer lobe projecting posterolaterally. Upper lip, apical margin broadly rounded with fine lateral and facial setae. Maxilla 2, inner plate slightly shorter than outer plate; with 11 plumose spine-setae, 6 distally and 4 on inner margin; outer plate with about 16 spines round the distal margin. Maxilliped, palp segment 4 present; shorter than outer plate; length twice greater than width; outer plate inner margin with 19–20 spines; inner plate greater than one-third length of outer plate; outer plate reaching middle of palp segment 3; inner plate with 5 or 6 stiff, plumed terminal setae.

Thoracic appendages. Gnathopod 1, coxa, anteroventral angle produced; basis sublinear, equal to merus, carpus, and propodus combined; basis with 7 stiff setae on anterior margin; carpus posterior margin slightly produced and heavily setose; carpus longer than propodus; propodus narrowed at base; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males without deep notch on anterior margin; palm convex, finely pectinate and subequal to dactyl; dactyl bifid distally. Gnathopod 2, coxa anterior margin with small triangular tooth produced downward, ventral margin sinuous, and posteroventral margin rounded; basis with 8 stiff setae on anterior margin and longer than basis of gnathopod 1; merus greater than length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus broad distally, or 2 to 2.5 times longer than wide; palm broadly convex; dactyl subequal to palm, or bifid distally. Pereopods 3–7, basis length 3 to 4 times width; prehensile or parachelate; propodus widened distally; coxal gills weakly pleated. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa less than three times its basal width; basis with anterodistal and posterodistal spines; merus shorter than basis, longer than carpus and propodus combined; merus with 4 anterodistal spines, with 4 anteromarginal spines, and with several large posteromarginal spines and posterodistal spines; carpus slightly shorter than propodus; carpus with 1 long posterodistal spine; propodus with 1 large curved spine at posterodistal projection and with 3 anterior marginal spines; palm of propodus deeply recessed, subtriangular. Pereopod 4, coxa anteroventral margin produced into blunt tooth, posteroventral margin rounded; posteroventral angle of coxa rounded; Pereopod 4, basis with anteromarginal spines and setae, or with posteromarginal spines; merus subequal to carpus and propodus combined; merus with 6 anteromarginal spines and with several large posteromarginal spines. Pereopod 5, coxa, posterior margin rounded and with a strong anteroventral process; basis expanded proximally, length less than two times width and longer than merus, with posterior lobe at base; basis with 5 posteromarginal spines; merus equal to carpus and propodus combined; merus with 3–4 posterodistal spines and with 4 posteromarginal spines; carpus shorter than propodus; carpus with 2 strong posterodistal spines and with 2 posteromarginal spines; propodus with 3 medial spines on palm, with 2–3 anteromarginal spines, and with a large curved posterodistal spine. Pereopod 6, coxa shaped like coxa 5, but smaller; basis subequal to merus; basis with 1 anterodistal spine, with 1 posterodistal spine, and with 6 anteromarginal and posteromarginal spines; merus with 7–8 anteromarginal spines, with 2–3 posteromarginal spines, with posterodistal spines, and with anterodistal spines; carpus with 1 posteromarginal spine, with 3 anteromarginal spines, and with anterodistal and posterodistal spines; propodus palm with short, thick medial spine, with 2–3 anteromarginal spines, and with 1 large curved spine at posterodistal projection. Pereopod 7, coxa similar in shape to coxa 5 and 6 but smaller;

basis with 4–5 anteromarginal spines, weakly expanded proximally, and with strong posterior spines; merus shorter than basis; merus anterior margin with 6 spines, or posterior margin with 4 spines, or with a strong anterodistal spine; carpus with anterodistal and posterodistal spines and with 3 strong anteromarginal spines; dactyl less than half length of carpus; propodus produced posterodistally with 1 long curved spine, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, ventral margin with 8–10 short setae, tapered distally, and posteroventral corner evenly rounded; 2, with a strong posterodistal spine and squarish; epimera 2 and 3, anteroventral margin with setae; 3, posteroventral margin acuminate; 3, ventral margin with 3 short spines. Urosomite 1, posteroventral margin with 2 spines and with long simple setae. *Abdominal appendages.* Urosomite 1, dorsal margin with a proximal saddle-shaped concavity and smoothly rounded. Urosomites 2–3, with small dorsal spines and paired lateral ridges and fused with a mid-dorsal saddle-shaped indentation; urosomite 2–3, dorsolateral margins forming keels running out to form straight a strong tooth. Uropod 1, shorter than uropod 3; peduncle dorsolateral margin with a row of strong spines and 1 interramal spine and fringed with ventral setae; inner ramus shorter than outer ramus; peduncle subequal to inner ramus; rami outer ramus with dorsolateral spines and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle slightly longer than rami with 1–4 outer marginal spines; inner ramus subequal to peduncle; outer ramus subequal to inner ramus; rami with long apical spines. Uropod 3, peduncle one half length of inner ramus; with dorsal spines; rami wide proximally, tapering to apices; inner ramus with 8 spines and outer ramus with 6–8 spines; inner ramus longer than outer ramus; exceeding telson; outer ramus shorter than inner. Telson, broadest medially; less than half as long as broad; cleft at least 90 percent to base; attaining middle of uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Type locality with volcanic mud (Stebbing, 1888)

Depth occurrence. 56 – 250 m.

Distribution. Kerguelen Island, South Indian Ocean.

Remarks: This form was described by Stebbing (1988) as *Tritaeta kergueleni* from the *Challenger* stations near the Kerguelen Islands of the Southern Indian Ocean. It was dredged from off Royal Sound and Cumberland Bay at 56-250 meters from volcanic mud. Stebbing (1888) placed the material in the genus *Tritaeta* despite at least one character which the Kerguelen material does not possess – the distal part of the outer plate of the maxilliped have spines (Boeck, 1876). The material figured by Stebbing (1888) and material examined for this report from the type locality indicates a complete row of marginal spines on the outer plate of the maxilliped. Holman and Watling (1983) stated that *Polycheria antarctica* f. *kergueleni* is closest to the new form they described *Polycheria antarctica* f. *nudus.* In the cladistic analysis for this report, *P. antarctica* f. *kergueleni* was consistently placed in the more derived clade representing species of the Pacific Ocean and Western Atlantic Ocean.

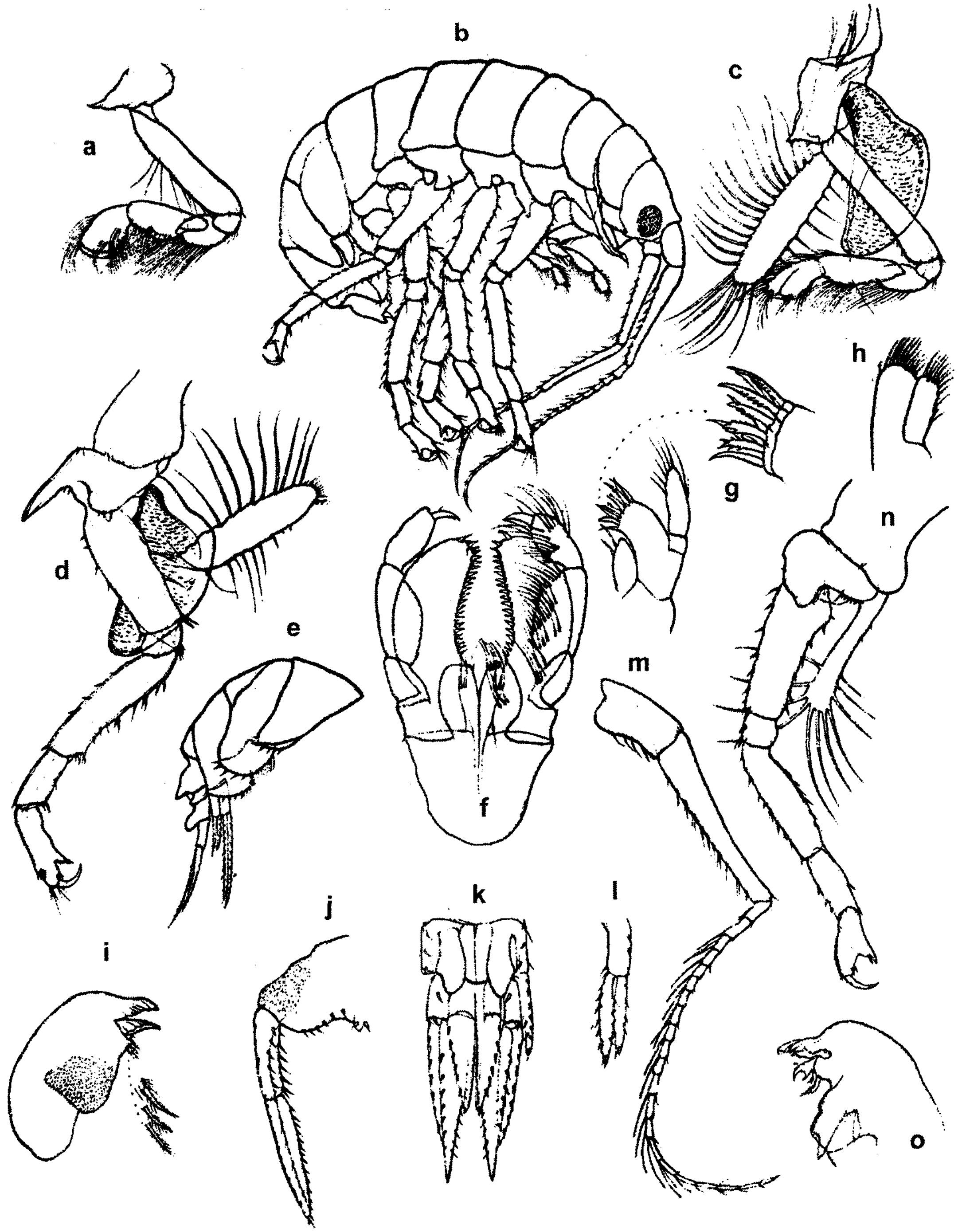

Figure 26 - *Polycheria antarctica* form *kergueleni* (Stebbing, 1888). Modified from Stebbing, 1888. a, gnathopod 1; whole animal; gnathopod 2; d, pereopod 3; pleosome and urosome; f, maxilliped; g, maxilla 1 with detail of outer plate; h, maxilla 2; left mandible; j, uropod 1; k, uropod 3 and telson; l, uropod 2; m, antenna 1; n, pereopod 5; o, right mandible.

Polycheria antarctica form *macrophthalma* of Schellenberg

Figure 27

Synonyms. *Polycheria antarctica* form *macrophthalma* Schellenberg, 1931: 220, fig. 107e, 112; Thurston, 1974b: 18; Lowry and Bullock, 1976: 37–38; *Polycheria kergueleni*. - Barnard and Karaman, 1991: 272; Debroyer and Jazdzewski, 1993: 34; Debroyer and Rauschert, 1999: 283.

Material Examined. 1 ovigerous ♀ 6.0 mm, 1 ♀ 6.0 mm, 4 juveniles 2.5 – 5.0 mm, MNB 29 913, Ultima Esperanza, Strait of Magellan, 5 April 1896, 12-18 m, among stones and algae.

Type locality. Ultima Esperanza, Strait of Magellan

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head twice width of pereonite 1. Eye, three fourths width of head; eye round; eye light brown in alcohol. Rostrum absent. Antenna 1, shorter than antenna 2; peduncle segment 1 short and stout, segment 2 less stout; flagellum with 10–20 articles. Antenna 2, about one-half body length; peduncle article 3 shorter than 2 and article 5 longer than 4; flagellum subequal to peduncle. Mandible, spine row 2–3; molars triturative; teeth on lacina mobilis 3; palp absent. Maxilla 1, inner plate apex rounded; with one terminal seta; outer plate truncate terminally; outer plate with 9 spines; palp long, exceeding spine row of outer plate; palp sublinear, tapered distally; palp with 9 terminal and subterminal setae. Lower lip, outer lobe projecting posterolaterally. Upper lip, apical margin broadly rounded with fine lateral and facial setae. Maxilla 2, inner plate subequal to outer plate; with 6–7 terminal and outer marginal stiff setae; outer plate with 8–9 stiff plumed setae terminally. Maxilliped, palp segment 4 present; exceeding outer plate; length less than width of segment 3; outer plate inner margin with 6–9 spines and with spines and setae on distal third; inner plate greater than one-third length of outer plate; outer plate reaching distal margin of palp segment 3; inner plate with 5 or 6 stiff, plumed terminal setae.

Thoracic appendages. Gnathopod 1, coxa, anteroventral angle produced; basis widened distally; basis with sparse setae on posterior margin and with sparse setae on anterior margin; carpus with facial and posteromarginal setae and posterior margin slightly produced and heavily setose; propodus short and deep, width 60% of length; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males without deep notch on anterior margin; palm convex, finely pectinate; dactyl bifid distally and exceeding palm, broadly curved. Gnathopod 2, coxa distally rounded; basis longer than basis of gnathopod 1; merus greater than length of carpus; merus posterior margin with elongate setae; propodus subequal to carpus; propodus oblong, three times as long as broad; palm defined by two slender distal spines and broadly convex; dactyl bifid distally. Pereopods 3–7, prehensile or parachelate; coxal gills weakly pleated. Pereopods 5–7, coxae broad, length more than twice width. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; basis with posterodistal spines; merus longer than propodus; merus with several large posteromarginal spines and posterodistal spines; carpus subequal to propodus; carpus with 2 anterodistal spines; propodus with 1 large curved spine at posterodistal projection and with 3 anterior marginal spines; palm of propodus with 1 medial spine, or deeply recessed, subtriangular. Pereopod 4, anteroventral angle of coxa broadly rounded; posteroventral angle of coxa produced to form sharp tooth; Pereopod 4, basis with several posteromarginal slender setae, or with 1 posterodistal spine; merus subequal to carpus and propodus combined; merus with 1 posterodistal spine and with 2 posteromarginal spines. Pereopod 5, coxa, deeper anteriorly, tapering posteriorly, with strong anteroventral process; basis expanded proximally, length less than two times width; basis with 2 posterodistal spines; merus shorter than carpus and propodus combined; merus with 1 posterodistal spine; carpus with 1 posteromarginal spine, with 2 strong posterodistal spines, and with 1 long anteromarginal spine; propodus with 2–3 anteromarginal spines and with a large curved posterodistal spine. Pereopod 6, coxa wider than long, with a triangular tooth anteriorly, and ventral margin irregular; basis with anterodistal setae, longer than merus, and with posterodistal setae; merus with 2–3 posteromarginal spines, with posterodistal spines, with 3 short anterior marginal spines and 3 long stiff setae, and with anterodistal spines; carpus with 1 posteromarginal spine, with 3 anteromarginal spines, and with anterodistal and posterodistal spines; propodus palm with short, thick medial spine, with 2–3 anteromarginal spines, with 1 large curved spine at posterodistal projection, and with anterodistal setae. Pereopod 7, coxa posteroventral angle produced, acute and anteroventral margin produced, bluntly rounded; basis posterodistal setae and linear; merus shorter than basis; merus with 2–3 long anterodistal and posterodistal spines, or with anterior and posterior marginal setae; carpus with anterodistal and posterodistal spines, with 1 long posteromarginal spine, with long anteromarginal spines, and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus produced posterodistally with 1 long curved spine, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, ventral margin with 3–4 setae and posteroventral angle with a small, triangular tooth; 2, with small tooth; 3, posteroventral margin with tooth; 3, ventral margin with 2–3 short setae.

Abdominal appendages. Urosomite 1, dorsal margin with a proximal saddle-shaped concavity and dorsal keel with acute posterior process. Urosomites 2–3, fused with a mid-dorsal saddle-shaped indentation; 2 and 3, with 1 proximal spine; urosomite 2–3, dorsolateral margins forming keels running out to form straight a strong tooth. Uropod 1, shorter than uropod 3; peduncle dorsolateral margin with a row of strong spines and 1 interramal spine and with several long setae on distal margin; rami subequal; peduncle subequal to inner ramus; rami with apical spines, outer ramus with dorsolateral spines, and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle equal to outer ramus in length; inner ramus longer than peduncle and longer than outer ramus; rami with long apical spines and outer margin of outer ramus with 4–5 spines. Uropod 3, peduncle one half length of inner ramus; with 2 distal spines; rami wide proximally, tapering to apices; both rami strongly spinose marginally; inner ramus three times as long as peduncle; longer than uropod 1 and telson; outer ramus two thirds length of inner ramus. Telson, triangular, acute distally; length more than twice width; cleft at least 90 percent to base; attaining middle of uropod 3; lateral setation present; with 2–3 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Among stones and algae.

Depth occurrence. 12 – 18 m.

Distribution. Magellanic region of South America, southern Chile.

Remarks: Thurston (1974a) places *P. antarctica* form *macrophthalma* in Group II of Schellenberg (1931) in that is possesses an acute posteroventral angle of the coxa of pereopod 4. It is distinguished from *Polycheria antarctica* by the large size of its eyes. In *P. antarctica* f. *macrophthalma,* the eyes in both sexes are at larger than half the diameter of the head. This form has occurred on several species lists from the Southern Ocean (Lowry and Bullock, 1976; Debroyer and Jazdzewski, 1993, Debroyer and Rauschert, 1999 and Barnard and Karaman, 1991) but has not been reported in a taxonomic paper since the time of its description. The type locality is rather isolated from the other South Atlantic and Antarctic Peninsula forms. No exact location was provided by Schellenberg (1931) for *P. antarctica* f. *macrophthalma,* just Ultima Esperanza. This is a large region far into the Strait of Magellan among a labyrinth of channels, fjords, and glaciers. Because of the far western location of Ultima Esperanza on the Strait of Magellan, it is possible that future collecting in the area might reveal this form has a Pacific coast affinity and there could be similar forms or species found on the Pacific coast of Chile, an area where *Polycheria* has not been previously reported.

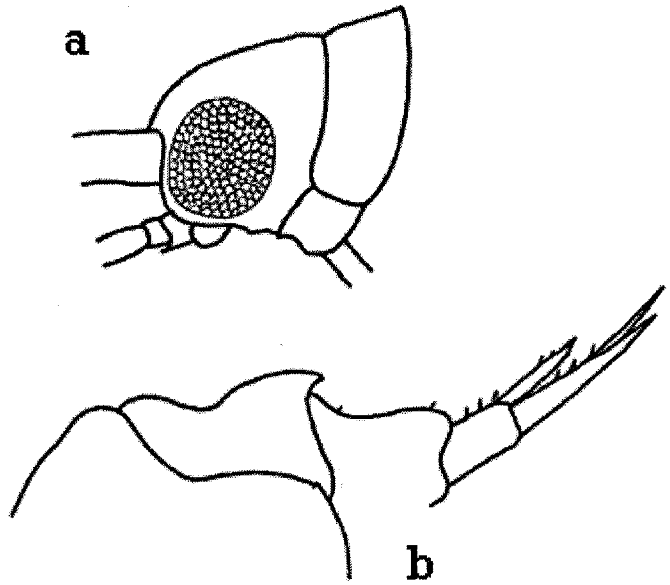

Figure 27 - *Polycheria antarctica* form *macrophthalma* Schellenberg, 1931. Modified from Schellenberg, 1931. a, head and pereonite 1; b, urosome with telson and uropod 3.

Polycheria antarctica form *nudus* of Holman and Watling

Figure 28

Synonyms. *Polycheria antarctica* form *nudus* Holman and Watling, 1983: 224, fig. 9; Lowry and Bullock, 1976: 37–38; *Polycheria nudus.* - Barnard and Karaman, 1991: 272; Debroyer and Jazdzewski, 1993: 34; Bousfield and Kendall, 1994: 49, fig. 25–4.

Materials. None available. Description from Holman and Watling, 1983.

Type locality. Antarctic Peninsula, 64° 41'S 54° 43'W [*Eltanin* Cruise 12, Station 1003] 15 March 1964.

Description. Head appendages. Mandible, palp absent. Maxilla 1, palp sublinear, tapered distally; with 5–6 terminal and subterminal setae. Maxilla 2, inner plate subequal to outer plate; with 6–7 terminal and outer marginal stiff setae; outer plate with 8–9 stiff plumed setae terminally. Maxilliped, palp segment 4 present; outer plate inner margin with 6–9 spines.

Thoracic appendages. Gnathopod 1, coxa, anteroventral angle produced; basis sublinear, equal to merus, carpus, and propodus combined; basis with sparse setae on anterior margin; carpus with anterodistal setae and with long setae on posterior margin; carpus longer than propodus; propodus twice as long as wide; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm exceeding length of dactyl. Gnathopod 2, propodus half as wide as long. Pereopods 3–7, prehensile or parachelate. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; posteroventral margin of coxa rounded; merus longer than propodus. Pereopod 4, merus longer than propodus. Pereopod 7, coxa rounded posteriorly; dactyl less than half length of carpus. Epimeral plate 3, posteroventral margin with a large triangular tooth.

Abdominal appendages. Urosomite 1, dorsal margin with small posterodorsal tooth. Urosomite 2–3, dorsolateral margins with rounded lobes. Uropod 1, peduncle subequal to inner ramus and much shorter than outer ramus. Uropod 2, peduncle subequal to rami. Uropod 3, inner ramus with 2–3 marginal spines and outer margin of outer ramus with 1–3 short spines; inner ramus three times as long as peduncle; exceeding telson; outer ramus shorter than inner. Telson, broadest proximally; cleft at least 90 percent to base; two thirds length of uropod 3; lateral setation absent; with no lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Unknown

Depth occurrence. 210–220 meters.

Distribution. Continental shelf in area of Antarctic Peninsula.

Remarks.: Little is known about this species. *P. antarctica* f. *nudus* is closest to *P. antarctica* f. *kergueleni*, based on the key presented by Thurston (1974). However, it is distinct on the basis of the following characters (1) the lack of marginal setae or spines on the telson; (2) epimeral plate 3, posteroventral with a large distinct tooth; (3) coxa 1, anteroventral corner bluntly produced and (4) the merus of pereopods 3-4 about 25% longer than the propodus (Holman and Watling, 1983). The absence of spines on the telson reflects the original of the specific name. Specimens from the type locality are in the USNM, but no labeled material for *P. antarctica* f. *nudus* is among that collection and apparently since it was described a form of *Polycheria.*

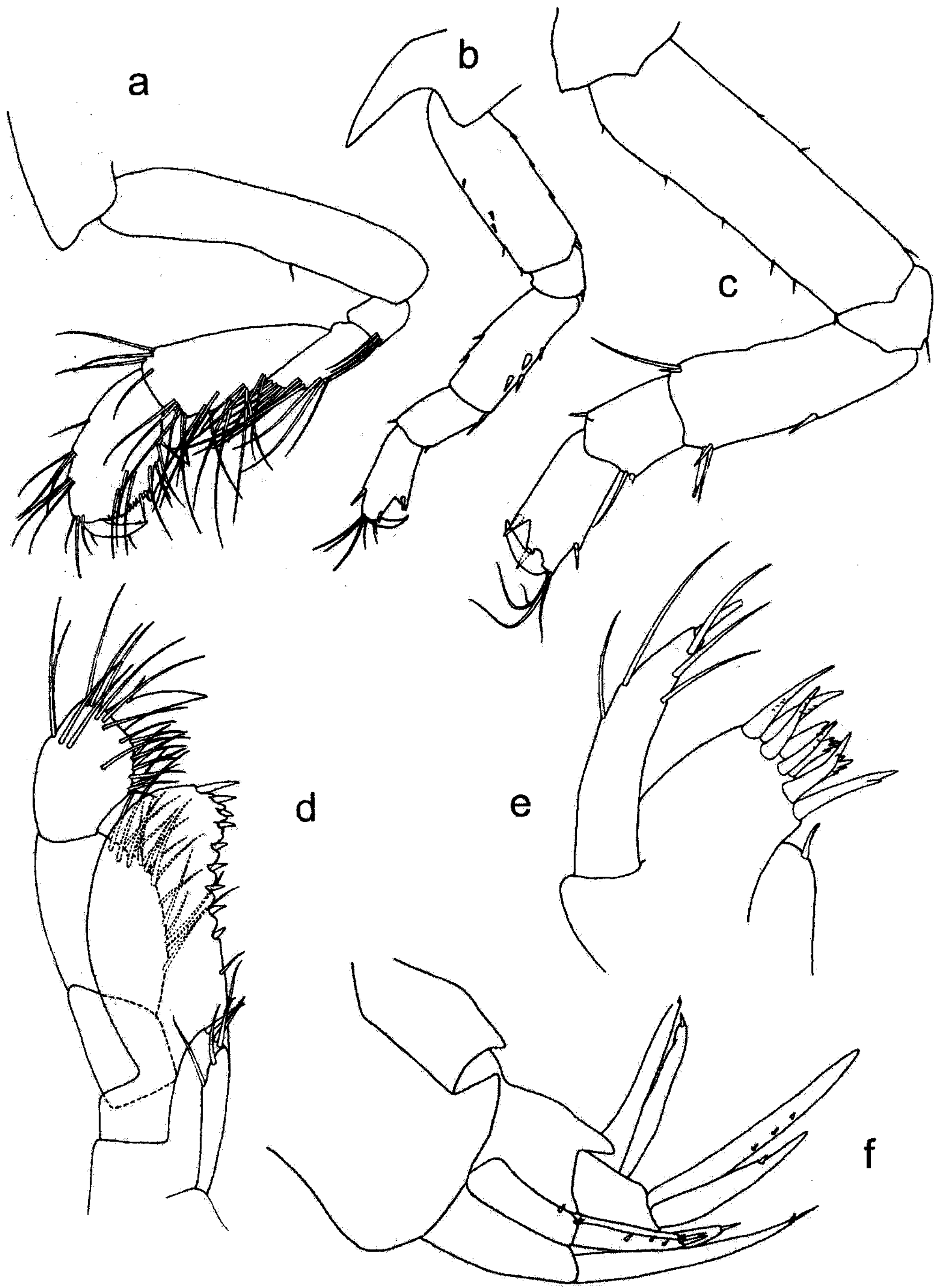

Figure 28 – *Polycheria antarctica* form *nudus* Holman and Watling, 1983. 3.5 mm ♀, *Eltanin* Cruise 12, Station 1003. a, gnathopod 1; b, pereopod 4; c, pereopod 7; d, maxilliped; e, maxilla 1; f. urosome. Adapted from Holman and Watling, 1983.

Polycheria antarctica form *similis* of Schellenberg

Figure 29

Synonymy. Polycheria antarctica form *similis* Schellenberg, 1931: 218, fig. 107c, 110; Thurston, 1974: 18; Lowry and Bullock, 1976: 37–38; *Polycheria similis.* - Barnard and Karaman, 1991: 272; Debroyer and Jazdzewski, 1993: 34; Debroyer and Rauschert, 1999: 283.

Materials. None available, description based on material presented in Schellenberg, 1931. That material includes several ♂♂, 4.0 – 7.5 mm, 1 ovigerous ♀, 7.5 mm, South Atlantic Ocean, 140 km south of Falkland Islands, 53° 41'S 61° 9'W, among gravel, stones, and some shells, 12 September 1902, depth 140-150 m; 1 juvenile, 4.5 mm, 2 ovigerous ♀♀, 6.5 mm, South Atlantic Ocean near the mouth of La Plata; 1 ovigerous ♀, 6.0 mm, Strait of Magellan, 52°20' S 67°39' W, depth 1.8 m, host *Amaroucium fuegiensis.*

Type locality. None defined.

Description. Head appendages. Antenna 2, peduncle article 5 longer than 4. Mandible, palp absent. Maxilla 1, inner plate with 3 terminal setae; outer plate with 7 spines; palp subequal to outer plate, outer plate sublinear with 4 terminal setae. Maxilliped, palp segment 4 present.

Thoracic appendages. Gnathopod 1, coxa, anteroventral margin produced into strong tooth; males without deep notch on anterior margin. Pereopods 3–7, prehensile or parachelate. Pereopod 3, merus longer than propodus. Pereopod 4, anteroventral angle of coxa produced to form a sharp tooth; posteroventral angle of coxa rounded. Pereopod 7, dactyl less than half length of carpus.

Habitat. Among gravel, stones, and shells; *Amaroucium fuegiensis* (Ascidiacea).

Depth occurrence. 140–450 m.

Distribution. Atlantic Ocean in vicinity of the mouth of La Plata; Strait of Magellan.

Remarks: The range of *P. antarctica* f. *similis* is reported somewhat wider than the other forms described by Schellenberg, 1931. It occurs from the Mar del Plata region, off central Argentina, southward to the Strait of Magellan, a range of 1700 kilometers. Chiesa et al., 2007 reports this species from the Strait of Magellan at 100 m. In the original description, Schellenberg (1931) stated that *P. antarctica* f. *similis* is closest morphologically to *P. antarctica* f. *kergueleni* by the following characters: (1) the dorsal keel of the urosome is less developed, slightly flattened; (2) antenna 2, peduncle segment 5 is slightly longer than peduncle segment 4; (3) the inner plate of maxilla 1 is widely rounded distally with 3 simple setae; (4) the outer plate of maxilla 1 lacks spines or setae except for the 4-5 terminal setae. As indicated in the description, *P. antarctica* f. *similis* falls into Schellenberg's Group I because of its rounded posteroventral margin of coxa 4. Except for the host record of the compound ascidian *Amaroucium fuegiense* (Cunningham, 1871), reported by Schellenberg (1931), nothing is known of its ecology.

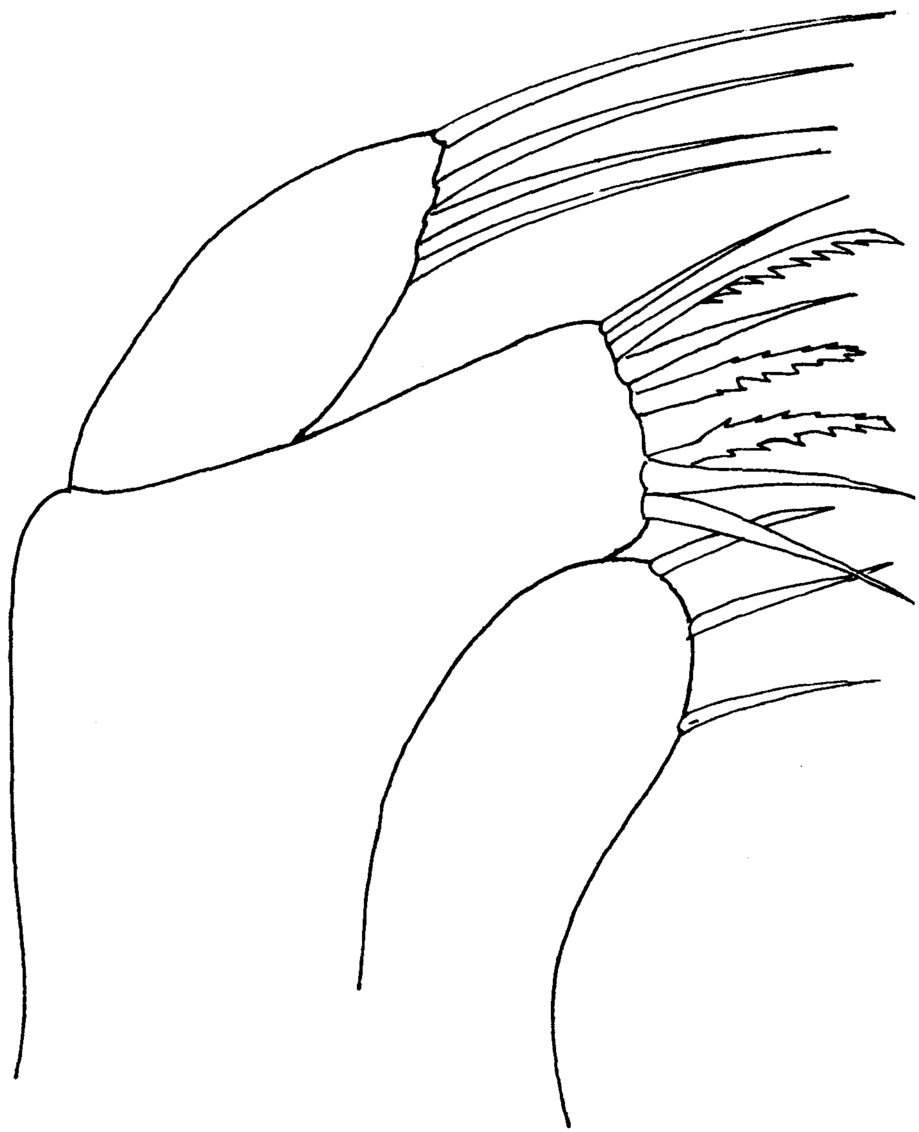

Figure 29 - *Polycheria antarctica* form *similis* Schellenberg, 1931. Redrawn from Schellenberg, 1931. Maxilla 1.

Indo-West Pacific Ocean/Australia/New Zealand species

Polycheria amakusaensis Hirayama

Figure 30-31

Synonyms. *Polycheria amakusaensis* Hirayama, 1984: 194–200, figs. 106–108; Barnard and Karaman, 1991: 271; Bousfield and Kendall, 1994: 46–47 figs. 23, 24; Ishimaru, 1994: 43.

Materials. None available, description based on Hirayama, 1984.

Type locality. Tsuji Island, Japan; April, 1968; coll. T. Kijuchi. Holotype ♂ 4.5 mm, 9 paratypes; AMBL-amph 38 (Hirayama, 1984).

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–2 combined. Eye, greater than one-half width of head; eye rounded oval. Antenna 2, longer than one-half body length; peduncle articles 4 and 5 equal; flagellum longer than peduncle. Mandible, molars unequal in size; palp absent. Maxilla 1, inner plate apex rounded; with dense inner margin setae, without distal setae; outer plate truncate terminally; outer plate with 9 spines; palp long, not exceeding spine tips on outer plate; palp sublinear, not tapering distally; palp truncate distally, with several distal teeth. Lower lip, outer lobe projecting posterolaterally. Upper lip, apical margin slightly concave with fine bristles. Maxilla 2, inner plate slightly shorter than outer plate; with dense medial and outer marginal setae; outer plate with dense terminal setae. Maxilliped, palp segment 4 present; subequal to outer plate; length equal to width of palp segment 3; outer plate with spines and setae on distal third; inner plate greater than one-third length of outer plate; outer plate reaching distal margin of palp segment 3; inner plate with 7–8 spines on distal half of inner margin, several terminals spines.

Thoracic appendages. Gnathopod 1, coxa rounded below; coxa, distally rounded, wider than deep; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anterior margin with several long setae and posterodistal margin with 2–3 long setae; carpus with long setae on posterior margin; carpus longer than propodus; propodus subovate; propodus shorter than carpus; males without deep notch on anterior margin; palm exceeding length of dactyl; dactyl short, strongly curved. Gnathopod 2, coxa subrectangular with distal angles rounded; basis shorter than basis of gnathopod 1; merus greater than length of carpus; propodus shorter than carpus; propodus narrowed proximally, subequal to carpus; palm short; palm short, poorly defined; dactyl strongly recurved proximally. Pereopods 3–7, basis broader than distal segments; carpus longer than propodus; prehensile or parachelate; propodus not widened distally. Pereopods 3 and 4, carpus longer than propodus. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa produced anteriorly into sharp tooth; process of coxa produced and bluntly rounded; posteroventral margin of coxa acuminate or acute; basis posterior margin with sparse setae; merus equal to carpus and propodus combined; carpus longer than propodus. Pereopod 4, anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa produced to form sharp tooth; merus subequal to carpus and propodus combined. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis expanded proximally, length less than two times width; merus longer than carpus and propodus combined. Pereopod 6, coxa with a triangular tooth anteriorly; basis with a proximal knob-like process anteriorly. Pereopod 7, coxa rounded posteriorly; pereopods 5 and 7, carpus longer than propodus; basis weakly expanded proximally; merus shorter than basis; dactyl less than half length of carpus. Epimeral plate 1, posteroventral corner evenly rounded; 2, with small tooth; 3, posteroventral margin with tooth; 3, ventral margin with 2–3 short setae.

Abdominal appendages. Urosomite 1, dorsal margin dorsal keel with acute posterior process. Uropod 1, shorter than uropod 3; peduncle lacking marginal setae; rami subequal; peduncle subequal to inner ramus; rami outer ramus with dorsolateral spines and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle slightly longer than rami with 1–4 outer marginal spines; inner ramus longer than peduncle; outer ramus shorter than inner; outer margin of outer ramus with 4–5 spines. Uropod 3, peduncle shorter than rami; rami wide proximally, tapering to apices; inner ramus with several marginal setae and outer margin of outer ramus with 1–3 short spines; inner ramus subequal to outer ramus; longer than uropod 1 and telson. Telson, broadest medially; half as broad as long; cleft at least 90 percent to base; shorter than uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Unknown.

Depth occurrence. Unknown.

Distribution. Japan, West Kyushu, Amakusa Islands, Sado Sea.

Remarks: This species is very similar to *P. orientalis.* It can be separated by the following character states (1) antenna 1, peduncle segment1 and antenna 2, peduncle segment 4 not strongly setose; (2) uropod 2, inner margin of inner ramus not setose; (3) pereopods 3-7, distal margin of palm with three teeth (sic), or spines; (4) telson slender, not rounded. Ishimaru (1994) reported this species in the Sado Sea area of Japan as part of a faunal catalogue, but no host was reported. *Polycheria amakusaensis* is otherwise unknown. Bousfield and Kendall (1994) made comparisons between *P. amakusaensis*, and its neighbour *P. orientalis*, to the East Pacific species of the genus and incorporated them into a key to North Pacific species, part of which is included in the key to species and forms in this report.

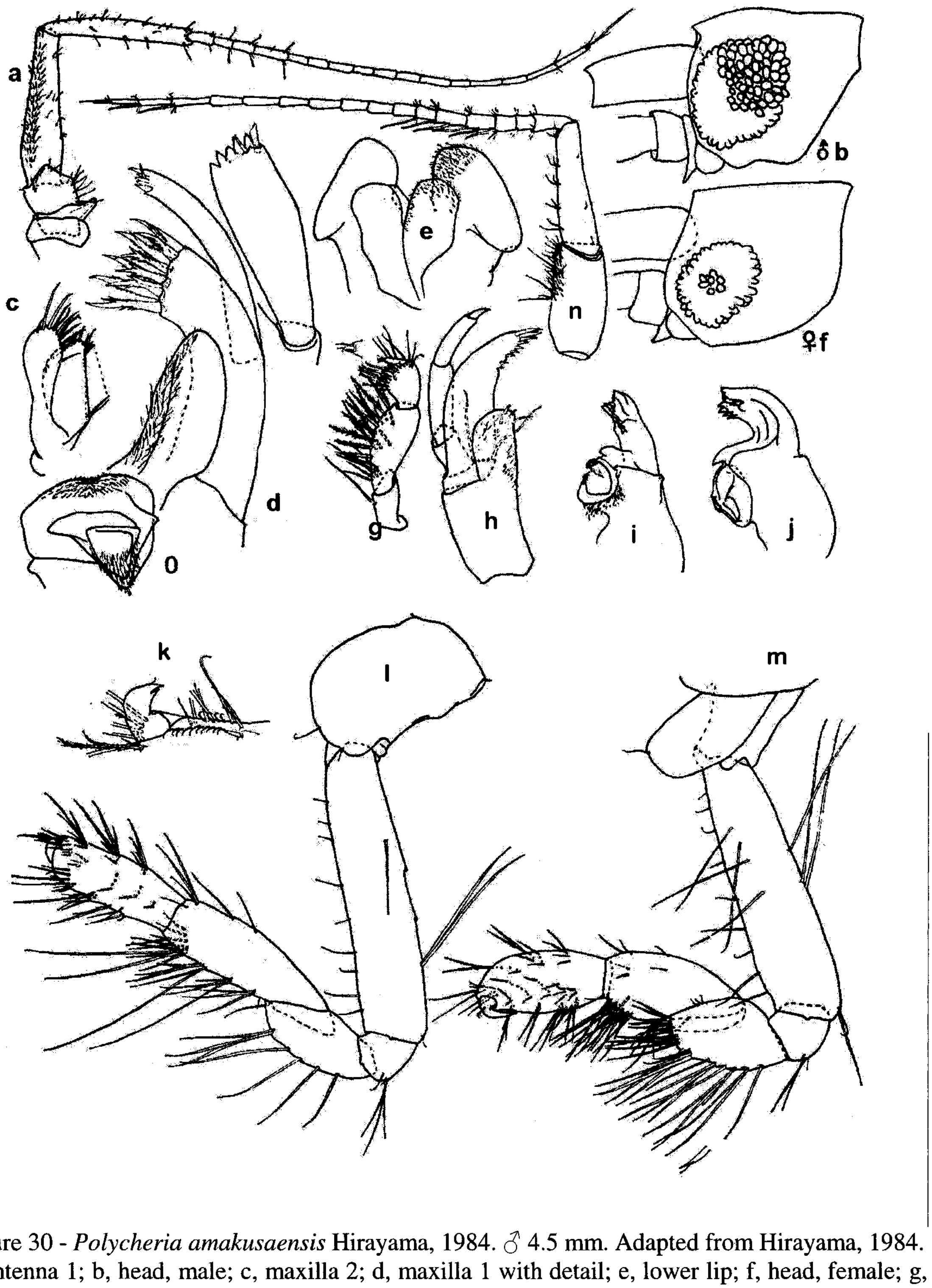

Figure 30 - *Polycheria amakusaensis* Hirayama, 1984. ♂ 4.5 mm. Adapted from Hirayama, 1984. a, antenna 1; b, head, male; c, maxilla 2; d, maxilla 1 with detail; e, lower lip; f, head, female; g, maxilliped palp, detail; h, maxilliped; i, left mandible; j, right mandible; k, gnathopod 1, detail of dactyl; l, gnathopod 1; m, gnathopod 2; n, antenna 2; o, upper lip.

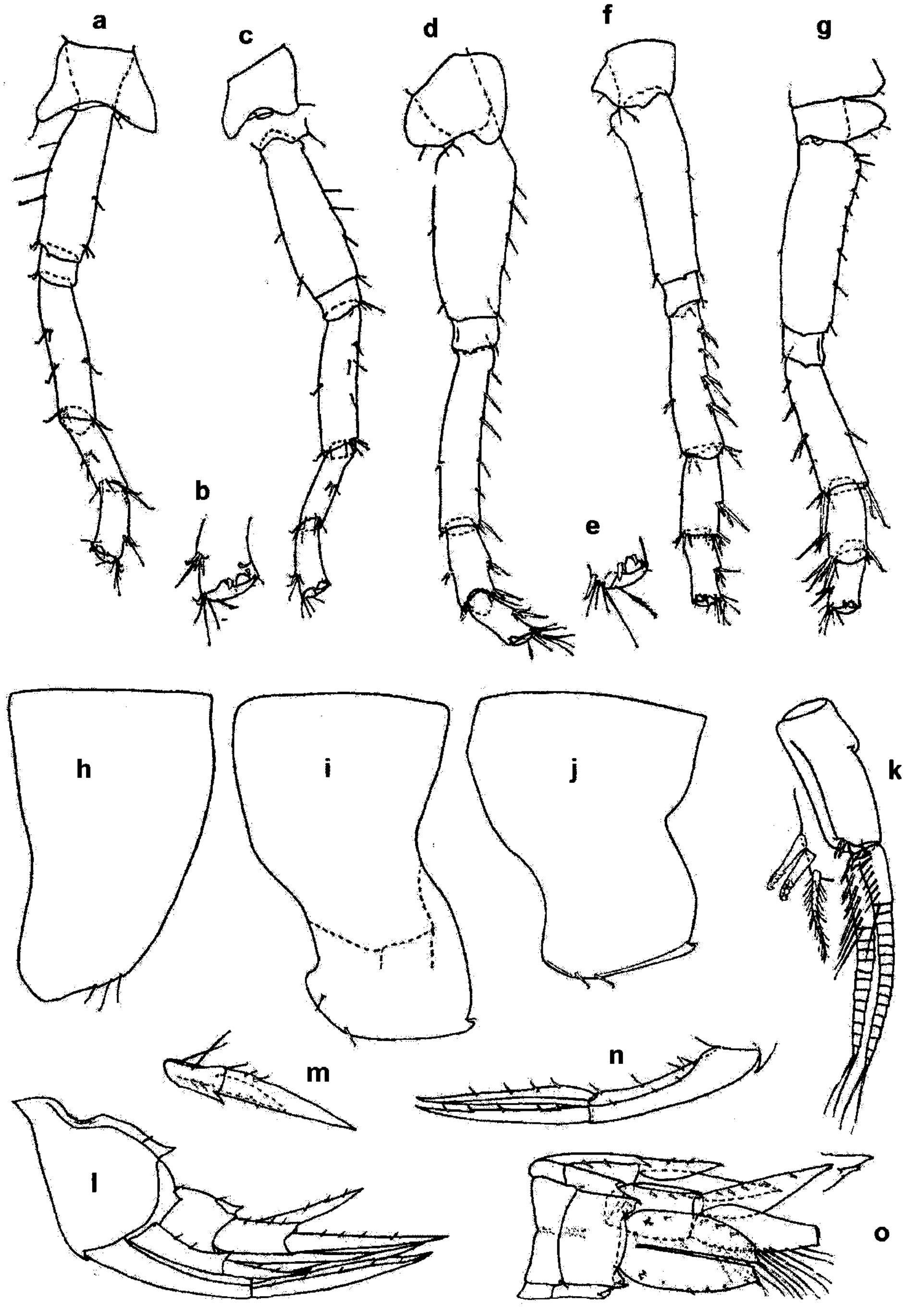

Figure 31 - *Polycheria amakusaensis* Hirayama, 1984. ♂ 4.5 mm. Adapted from Hirayama, 1984. a, pereopod 4; b, pereopod 3; c, pereopod 3 detail; d, pereopod 5; e, pereopod 5 detail; f, pereopod 6; g, pereopod 7; h, epimeral plate 1; i, epimeral plate 2; j, epimeral plate 3; k, pleopod 1; l, urosome; m, uropod 2; n, uropod 1; o, uropod 3.

Polycheria atolli Walker

Figure 32

Synonyms. Polycheria atolli Walker, 1905; 926–927, pl. 88, fig 1–5; Walker, 1909: 337; Chilton, 1912: 502; K.H. Barnard, 1916: 211; Schellenberg, 1925: 157, fig 15; K.H. Barnard, 1937: 378; K.H. Barnard, 1940; Pillai, 1957: 52–54, fig. 12, 1–9; J.L. Barnard, 1958: 39; J.L. Barnard, 1965: 470; Ledoyer, 1967: 205, fig. 13a; Ledoyer, 1972c: 205; Griffiths, 1973: 284; Griffiths, 1974a; 185; Griffiths, 1974b: 232; Griffiths, 1974c: 287; Griffiths, 1975: 96,99, 117; Griffiths, 1976: 36, 37; Ledoyer, 1979: 60; Ledoyer, 1982: 383–384, fig. 144; *Polycheria antarctica.* - Chilton, 1912: 502; K.H. Barnard, 1916: 211.; Schellenberg, 1925: 157, fig 15. *Polycheria orientalis atolli.* – Hirayama, 1984: 187, figs. 101, 103-105.

Material. None, description from the Walker (1905) and Ledoyer (1982).

Type locality. Hulule Island, Maldives, Indian Ocean

Description. Head appendages. Head, anteroventral margin rounded or obtuse. Eye, one half the width of head; eye ovate. Rostrum minute. Antenna 1, subequal to antenna 2. Antenna 2, peduncle article 5 shorter than 4. Mandible, palp absent. Maxilla 1, palp long, exceeding spine row of outer plate; truncate distally. Maxilliped, palp segment 4 present; outer plate with spines and setae on distal third.

Thoracic appendages. Gnathopod 1, coxa, anteroventral angle produced; basis widened distally; basis anterior margin with several long setae; carpus with facial and posteromarginal setae; carpus subequal to propodus; propodus ovate; propodus subequal to carpus; males without deep notch on anterior margin; dactyl exceeding palm, broadly curved. Gnathopod 2, basis longer than basis of gnathopod 1; propodus shorter than carpus; propodus 2 to 2.5 times longer than wide; palm short; palm distinct, oblique. Pereopods 3–7, basis broader than distal segments; prehensile or parachelate. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa three times or greater its basal width; merus longer than propodus; carpus subequal to propodus. Pereopod 4, anteroventral angle of coxa produced to form sharp tooth; posteroventral angle of coxa produced to form sharp tooth. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis subequal to merus with weak posterior lobe near base; merus shorter than carpus and propodus combined. Pereopod 6, coxa ventral angles rounded. Pereopod 7, coxa anteroventral angle rounded; merus subequal to carpus and propodus combined; dactyl less than half length of carpus; propodus palm with short, strong distomedial spine. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; 2, posterodistally produced, rounded and ventral margin with 2–3 short, curved spines; epimera 2 and 3, anteroventral margin without setae; 3, posteroventral margin with a large triangular tooth.

Abdominal appendages. Urosomite 1, dorsal margin dorsal keel with acute posterior process. Urosomite 2–3, dorsolateral margins with two short spines. Uropod 1, peduncle with two proximomedial spines and one distal spine; rami outer ramus with dorsolateral spines and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; inner ramus extending well beyond peduncle of uropod 3; outer ramus shorter than inner; inner margin of inner ramus with 1 or 2 proximal spines. Uropod 3, peduncle less than one half length of rami; rami lanceolate; rami without spines; inner ramus longer than outer ramus; exceeding telson; outer ramus slightly shorter than inner. Telson, triangular, acute distally; half as broad as long; cleft at least 90 percent to base; attaining middle of uropod 3; lateral setation present; with 1 lateral spine; apical spines absent; apical spines equal to marginal spines.

Habitat. Burrows into compound ascidians and sponges

Depth occurrence. Intertidal to 50 m.

Distribution. Maldives, Seychelles, Ceylon, British West East Africa (Kenya and Tanzania), Mediterranean Sea, South Africa, Cape Agulhas, Capetown, Madagascar.

Remarks: Walker (1905) described *P. atolli* from the Maldives in the Indian Ocean. He reported that the specimens met many of the morphological characters of *Tritaeta (=Polycheria) antarctica* (Stebbing, 1875). Walker chose to revive the genus *Polycheria* of Haswell, 1879 because his specimens more closely match the dactyls of that genus, rather than *Tritaeta* (the difference being the length, size, and closing characteristics of the dactyls of pereopods 3-5). Chilton (1912) synonomized *P. atolli* with *P. antarctica.* Schellenberg (1925) declined to follow Chilton's synonymy and records specimens of *P. atolli* from Southern Africa because they possessed a 1-articulate, apically truncate, and denticulate palp of maxilla 1. K.H. Barnard (1937) reported *P. atolli* from the Red Sea and Griffiths (1975) reported it from Saldanha Bay, South Africa, frequently burrowing in compound ascidians.

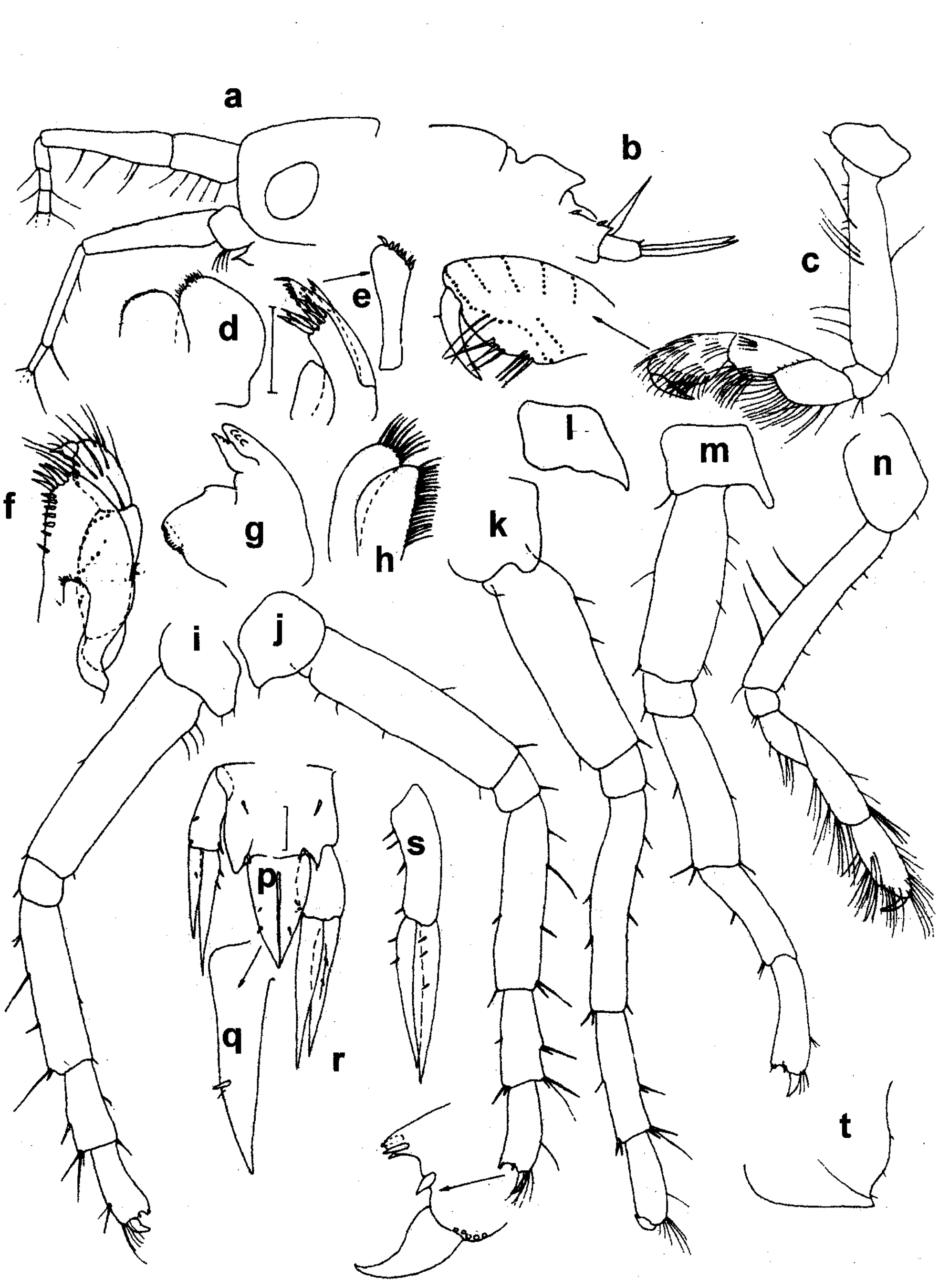

Figure 32 - *Polycheria atolli* Walker, 1905.♀. 3.5 mm, Madagascar. Adapted from Ledoyer, 1982. a, head; b, urosome; c, gnathopod 1 with detail; d, upper lip; e, maxilla 1 with detail of palp; f, maxilliped; g, mandible; h, maxilla 2; i, pereopod 7; j, pereopod 6 with detail; k, pereopod 5; l, coxa 4; m, pereopod 3; n, gnathopod 2; p, telson; q, uropod 3; r, uropod 2; s, uropod 1; t, epimeral plate 3.

Polycheria brevicornis Haswell

Figure 33

Synonyms. Polycheria brevicornis Haswell, 1879: 346; Haswell, 1882: 262-263; Stebbing, 1910: 644; Barnard and Karaman, 1991: 272. – *Polycheria tenuipes* Stebbing, 1906: 520; Lowry and Bullock, 1976: 37.

Materials. ♂, 3.7 mm (illustrated), 2 ♀♀ , AM-P3505, Port Jackson, New South Wales, Australia, 33° 85'S 151° 26'E (approximate location) No field data, old collection, possibly a syntype; type is lost.

Type locality. Port Jackson, Sydney, Australia

Description. Head appendages. Eye round. Rostrum minute. Antenna 1, shorter than antenna 2; peduncle segment 1 shorter than segment 2; flagellum with 10–2. Antenna 2, equal to antenna 1; peduncle article 5 shorter than 4; flagellum shorter than peduncle, with 10–11 segments. Mandible, palp absent. Maxilliped, palp segment 4 present.

Thoracic appendages. Gnathopod 1, coxa blunt, produced; coxa, posteroventral margin produced and bluntly rounded; propodus ovate; propodus subequal to carpus; males (notch) without deep notch on anterior margin. Gnathopod 2, coxa subrectangular with distal angles rounded; propodus shorter than carpus; propodus oblong, three times as long as broad; palm transverse. Pereopods 3–7, prehensile or parachelate. Pereopods 5–7, coxae broad, wider than deep. Pereopod 5–7 merus subequal or longer than carpus and propodus combined. Pereopod 3, anteroventral margin of coxa rounded anteroventrally; posteroventral margin of coxa acuminate or acute; basis with posterodistal spines; merus equal to carpus and propodus combined; propodus with 2 anterodistal spines and posterior margin produced, with 2–3 distal spines; palm of propodus not deeply recessed. Pereopod 4, coxa anteroventral and posteroventral margins acute; anteroventral angle of coxa produced to form sharp tooth; posteroventral angle of coxa acuminate. Pereopod 5, coxa, anteroventral and posteroventral angles rounded. Pereopod 6, coxa ventral angles rounded. Pereopod 7, coxa anteroventral margin produced, bluntly rounded and posteroventral margin produced into blunt lobe. Pleon segments 1–3 without dorsal teeth. Epimeral plate 3, posteroventral margin acuminate.

Abdominal appendages. Urosomite 1, dorsal margin extended posteriorly to mask part of urosomite 2–3 and strongly produced posteriorly to form blunt process. Urosomites 2–3, fused, with lateral ridges produced posteriorly into lobes; 2 and 3, with paired proximal and distal dorsal spines. Uropod 1, shorter than uropod 3; peduncle with a large, curved distolateral spine and with strong row of short spines on inner and outer dorsolateral margins; inner ramus subequal to peduncle and rami subequal; rami with apical spines and outer ramus with dorsolateral spines. Uropod 2, equal to uropod 1; outer ramus subequal to inner ramus. Uropod 3, peduncle with 1–3 dorsolateral spines; rami wide proximally, tapering to apices; inner ramus longer than outer ramus; longer than uropod 1 and telson. Telson, lateral setation present; with 2–3 lateral spines; apical spines present.

Habitat. Unknown.

Distribution. Southeast Australia.

Cosmopolitan geographical area. Australia and New Zealand.

Remarks. There is doubt that *P. brevicornis* warrants full species status. Lowry and Bullock (1976) considered it a synonym of *P. tenuipes* Haswell, 1879, the type species of the genus. It is not possible to discern clear differences between the two species from Haswell's (1879) descriptions or figures. Both were described from Port Jackson, Australia. If types were deposited for both specimens, they have since been lost (S.

Keable, Australian Museum, pers. comm.) Schellenberg (1931) did not recognize *P. brevicornis* in his review of the existing taxa of *Polycheria* and it was not included in the key to the forms of Schellenberg by Thurston (1974a). Barnard and Karaman (1991) included it in a list of published species and forms of *Polycheria.* A possible syntype, collected at the type locality, was obtained, described herein, and has been included in the cladistic analysis in order to assess its specific status.

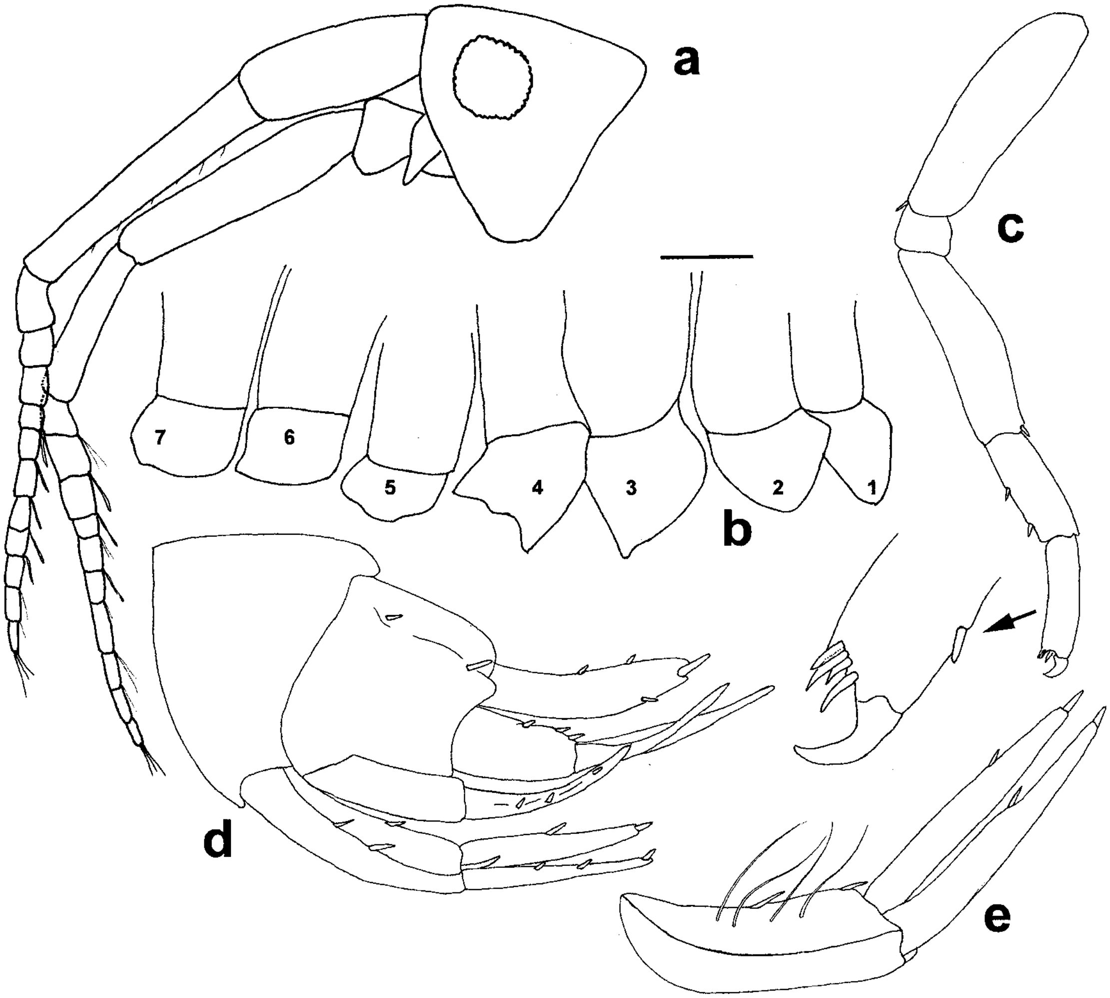

Figure 33 - *Polycheria brevicornis* Haswell, 1879. ♂, 3.7 mm, Port Jackson, Australia. AM-P-3505. a, head, antenna 1-2; b, coxal plates 1-7; c, pereopod 3; d, urosome; e, uropod 1. Scale = 0.25 mm - b, d.

Polycheria japonica Bulycheva

Figure 34

Synonyms. Polycheria japonica Bulycheva, 1952: 223–235, fig. 29; Barnard and Karaman, 1991: 271; Bousfield and Kendall, 1994: 44, fig. 23.

Materials. None, based on description in Bulycheva, 1952.

Type locality. Peter the Great Bay, Sea of Japan.

Description. Head appendages. Antenna 1, peduncle segment 1 shorter than segment 2. Antenna 2, peduncle articles 4 and 5 equal. Mandible, molars unequal in size; palp absent. Maxilla 1, outer plate with 9 spines; palp long, exceeding spine row of outer plate. Maxilla 2, inner plate strongly setose marginally. Maxilliped, palp segment 4 present, exceeds outer plate.

Thoracic appendages. Gnathopod 1, coxa rounded below; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis with sparse setae on anterior margin; carpus with long setae on posterior margin; carpus subequal to propodus; propodus short and deep, width 70% of length; propodus subequal to carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm distinct, oblique, not exceeded by dactyl. Gnathopod 2, coxa anterior margin with small triangular tooth produced downward and distally rounded; basis with a row of 10–13 short anteromarginal setae; propodus subequal to carpus; palm distinct, oblique. Pereopods 3–7, basis broader than distal segments; carpus longer than propodus; prehensile or parachelate. Pereopods 3 and 4, carpus longer than propodus. Pereopod 3, anteroventral margin of coxa lacking anteroventral process; process of coxa produced and bluntly rounded. Pereopod 4, anteroventral angle of coxa broadly rounded; posteroventral angle of coxa produced to form sharp tooth. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis expanded proximally, length less than two times width. Pereopod 6, coxa ventral angles rounded. Pereopod 7, dactyl less than half length of carpus. Epimeral plate 2, acuminate and ventral margin with 2–3 short, curved spines; 3, posteroventral margin acuminate.

Abdominal appendages. Urosomite 1, dorsal margin posterior margin concave. Urosomites 2–3, with small dorsal spines and paired lateral ridges. Uropod 3, outer ramus, outer margin spinose; inner ramus three times as long as peduncle; rami longer than peduncle and exceeding telson; outer ramus shorter than inner. Telson, broadest proximally; width two-thirds length; cleft about 80 percent to base; with 2–3 spines.

Habitat. Among seagrass *Zostera nana.*

Depth occurrence. Unknown

Distribution. Sea of Japan; Peter the Great Bay, Vladivostok area.

Remarks: Bousfield and Kendall (1994) discussed *P. japonica* in a comparison of West Pacific and East Pacific *Polycheria.* They separated species by geographic region by several characters, among them the extension of the posterior projection of urosomite 1. This projection partially overlaps the fused urosome segments 2-3 and separates the Asiatic species from the East Pacific species. *Polycheria japonica* differs from its Asiatic relatives by having subchelate gnathopods. The other two Northwest Pacific species, *P. orientalis* and *P. amakusaensis,* have very short palmar margins, rendering the gnathopods nearly simple. Bulycheva (1952) reported *P. japonica* associated with the seagrass *Zostera nana.*

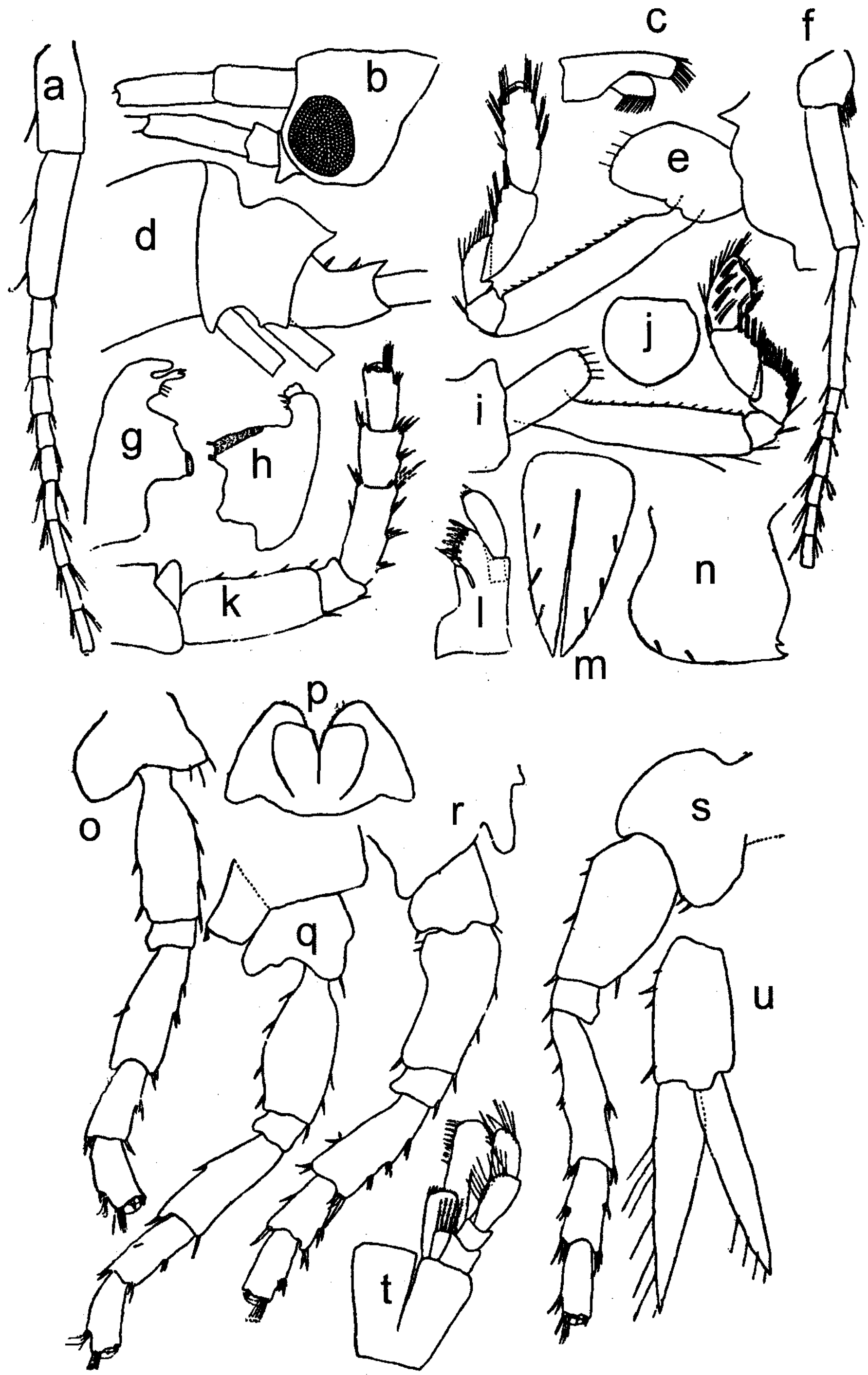

Figure 34 – Figure *Polycheria japonica*, 1952, ♂, 5.0 mm, Peter the Great Bay, Sea of Japan. Adapted from Bulycheva, 1952. a, antenna 1; b, head; c, maxilla 2; d, urosome e, gnathopod 2; f, antenna 2; g, left mandible; h, right mandible; i, gnathopod 1; j, upper lip; k, pereopod 7; l, maxilla 1; m, telson; n, epimeral plate 3; o, pereopod 4; p, lower lip; q, pereopod 3; r, pereopod 6; s, pereopod 5; t, maxilliped;, u, uropod 3.

Polycheria obtusa Thomson

Figure 35-36

Synonyms. Polycheria obtusa Thomson, 1882: 22, fig. 3, pl. 17; Hutton, 1904: 259; Barnard, 1972: 62–63, fig. 27; Barnard and Karaman, 1991: 266–267, fig. 53g, 59c; Debroyer and Jazdzewski, 1993: 34.

Materials. 1 ♂, 4.0 mm, 1 ovigerous ♀ AM-P-25935, St. Kilda Rocks, Kaikoura, New Zealand, depth 3-4 m, on *Caulerpa brownii*, 8 November 1973, 42° 25'S 173° 42' E, coll. G. Fenwick.

Type locality. Patterson Inlet, New Zealand

Description. Head appendages. Head, anteroventral margin produced into a rounded lobe; head large, equal to pereonites 1–2 combined. Eye, one half width of head; eye rounded oval; eye light brown in alcohol. Rostrum absent. Antenna 1, longer than half length of body; peduncle segment 1 short and stout, segment 2 less stout and 3 equal to first flagellar segment, shorter than segment 2; flagellum with less than 10 articles. Antenna 2, about one-half body length and longer than antenna 1 in male; peduncle article 1 very short, 2 and 3 long and slender and article 5 shorter than 4; flagellum longer than peduncle. Mandible, palp absent. Maxilliped, palp segment 4 present.

Thoracic appendages. Gnathopod 1, coxa rounded below; coxa, distally rounded, deeper than wide and not produced anteroventrally, distally rounded; basis sublinear, equal to merus, carpus, and propodus combined; basis with sparse setae on posterior margin; carpus with long setae on posterior margin; carpus longer than propodus; propodus short and deep, width 60% of length and ovate; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae; males without deep notch on anterior margin; palm shorter than dactyl; dactyl exceeding palm, broadly curved. Gnathopod 2, coxa anteroventral margin not produced forward, distally rounded; basis with anteromarginal setae and with posteromarginal setae; merus less than half length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus 2 to 2.5 times longer than wide; palm length equal to dactyl; palm distinct, oblique; dactyl shorter than palm. Pereopods 3–7, basis broader than distal segments; prehensile or parachelate; merus longer than carpus and propodus combined; propodus not widened distally. Pereopods 3 and 4, carpus equal to propodus. Pereopods 5–7, coxae broad, length more than twice width. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa produced and bluntly rounded and less than three times its basal width; posteroventral margin of coxa rounded; basis with anterodistal and posterodistal spines; merus equal to carpus and propodus combined; merus with 1 posterior marginal spine and 1 posterodistal spine; carpus slightly shorter than propodus; carpus with 1 long posterodistal spine; propodus with 2 anterodistal spines, with 1 large curved spine at posterodistal projection, posterior margin produced, with 2–3 distal spines, and with 1 short distomedial (palmar) spine. Pereopod 4, coxa anteroventral margin produced into blunt tooth, posteroventral margin rounded; merus subequal to carpus and propodus combined, subequal to propodus, and longer than propodus; merus with 1 anteromarginal and 1 anterodistal spine, with 1 posterodistal spine, and with 2 posteromarginal spines. Pereopod 5, coxa, anteroventral and posteroventral angles rounded and with a strong anteroventral process; basis expanded proximally; basis with one posterodistal spine and with 3 anteromarginal spines; merus longer than carpus, propodus, and dactyl combined; merus with 2 posterodistal spines;

carpus subequal to propodus; carpus with 2 strong posterodistal spines and with 1 long anteromarginal spine; propodus with 2–3 anteromarginal spines, palm with a short, thick medial spine, and with a large curved posterodistal spine. Pereopod 6, coxa with a triangular tooth anteriorly and shaped like coxa 5, but smaller; basis with a posterior proximal knob and longer than merus; basis with 1 posterodistal spine; merus with 2 anteromarginal spines, with posterodistal spines, and with anterodistal spines; carpus with 1 anteromarginal spine and with anterodistal and posterodistal spines; propodus palm with short, thick medial spine, with 2–3 anteromarginal spines, with 1 large curved spine at posterodistal projection, and with strong anterodistal an posterodistal spines. Pereopod 7, coxa similar in shape to coxa 5 and 6 but smaller; basis with 1 posterodistal spine, with 2–3 small posteromarginal spines, and weakly expanded proximally; merus longer than carpus, propodus, and dactyl combined; merus anterior margin with 1 spine and with 2–3 long anterodistal and posterodistal spines; carpus with 1 anteromarginal spine, with anterodistal and posterodistal spines, and anterodistal spines half length of propodus; propodus produced distally with 2–3 spines, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, ventral margin with 3–4 slender spines and posteroventral angle with a small, triangular tooth; 2, posteroventral angle with a small triangular tooth and ventral margin with 3–4 slender spines; epimera 2 and 3, anteroventral margin without setae; 3, posteroventral margin with a small triangular tooth; 3, ventral margin with 3–4 slender spines.

Abdominal appendages. Urosomite 1, dorsal margin strongly produced posteriorly to form blunt process. Urosomites 2–3, fused, with no dorsal saddle shaped indentation; 2 and 3, with paired proximal and distal dorsal spines; urosomite 2–3, dorsolateral margins forming keels, running out to form acute lobes. Uropod 1, shorter than uropod 3; peduncle with a large, curved dorsolateral spine and lacking marginal setae; rami subequal; peduncle longer than rami; rami with apical spines, outer ramus with dorsolateral spines, and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle with 2 dorsolateral spines and equal to outer ramus in length; inner ramus longer than outer ramus; outer ramus shorter than inner; rami with long apical spines. Uropod 3, peduncle subequal to outer ramus; with 1–3 dorsolateral spines; rami lanceolate; outer margin of outer ramus with 1–3 short spines; inner ramus shorter than outer and longer than outer ramus; longer than uropod 1 and telson; outer ramus three-fourths length of inner ramus. Telson, triangular, acute distally, broadly lanceolate, acute distally, and broadest medially; half as broad as long; cleft about 80 percent to base; two thirds length of uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines

Habitat. Among fouling organisms (Inglis et al., 2006), including sponges and ascidians.

Depth occurrence. 30 meters.

Distribution: New Zealand, Blueskin Bay.

Remarks. Polycheria obtusa is the most pleisomorphic species of the genus, based upon the 50% majority rule consensus tree generated from the analysis of characters from all the species and forms in this report (Chapter 5). This species has not been reported outside New Zealand, but has been listed several times in recent years as part of the effort to characterize the fouling communities of New Zealand's harbors regarding invasive species (Inglis et al., 2006).

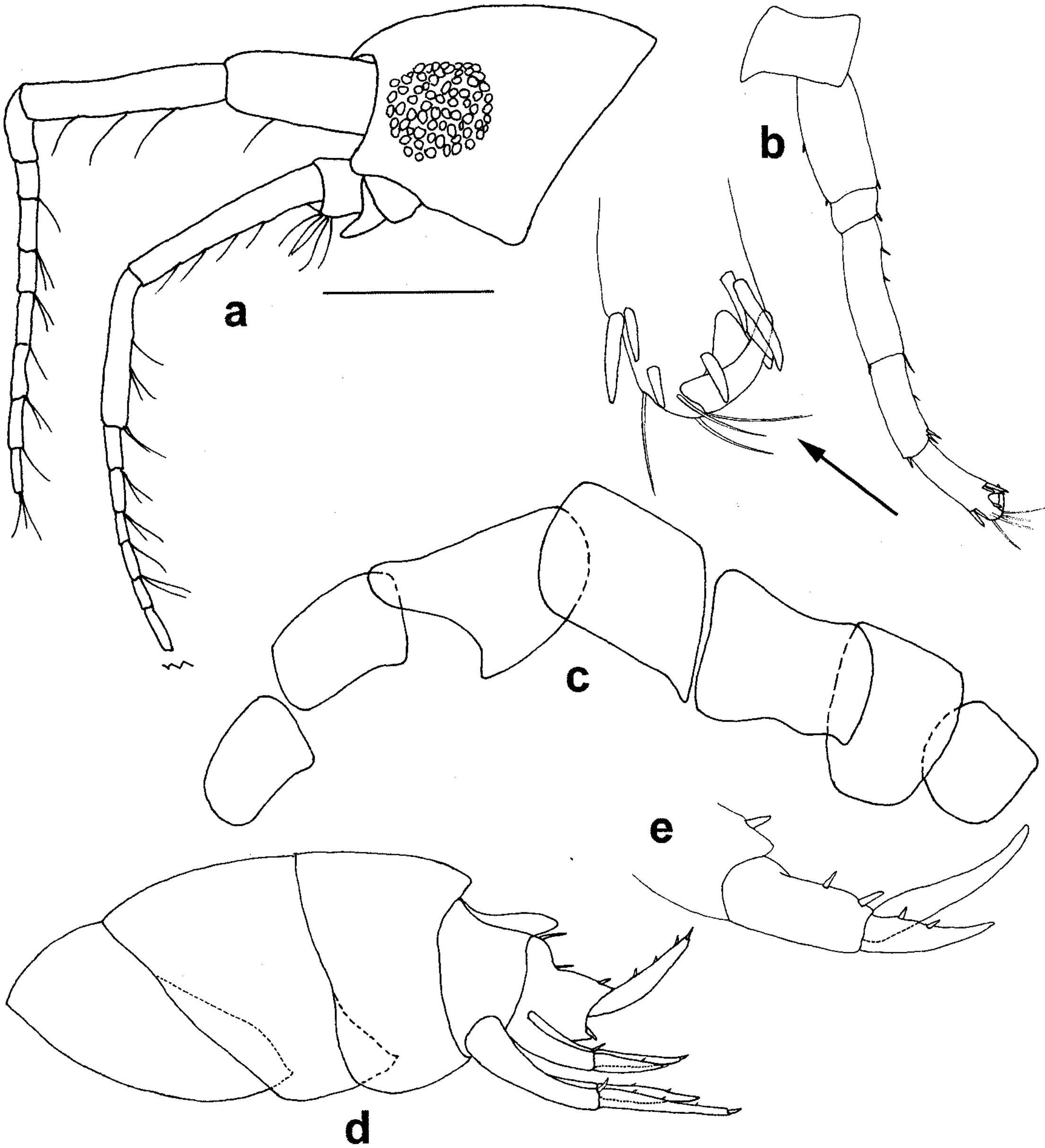

Figure 35 - *Polycheria obtusa* Thomson, 1882. ♂, 4.0 mm, AM-P-25953, St. Kilda Rocks, Kaikoura, New Zealand. a, head and antenna 1-2; pereopod 4 with detail; c, coxal plates 1-7 (right to left); d, pleosome and urosome; e, uropod 3. Scale = 0.5 mm – a.

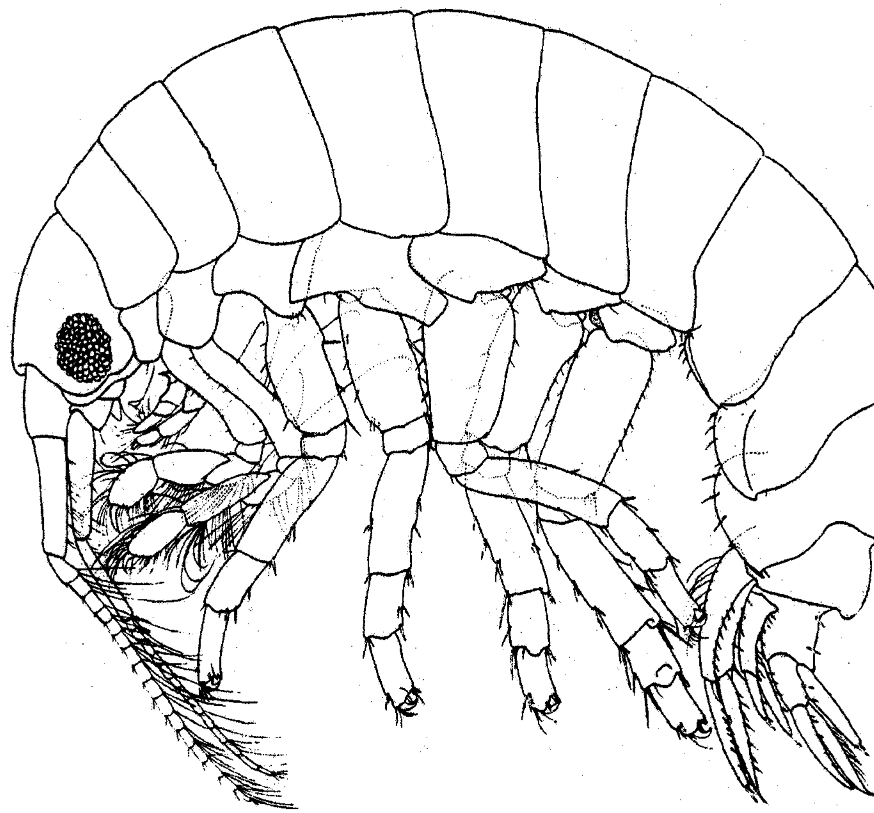

Figure 36 – *Polycheria obtusa* Thomson, 1882. ♀, 7.2 mm, Blueskin Bay, New Zealand. Modified from Barnard, 1972.

Polycheria orientalis Hirayama

Figure 37-39

Synonyms. Polycheria atolli orientalis Hirayama, 1984: 187, fig. 101–105. *Polycheria orientalis.* - Barnard and Karaman, 1991: 272; Ishimaru, 1994: 43; Bousfield and Kendall, 1994: 47–49, fig. 24a.

Materials. None available. Description based on Hirayama, 1984.

Type locality. Shijiki Bay, Japan.

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–3 combined. Eye, greater than one-half width of head; eye ovate. Rostrum absent. Antenna 1, peduncle segment 1 short and stout, segment 2 less stout and 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, equal to antenna 1; peduncle articles 4 and 5 equal; flagellum subequal to peduncle. Mandible, molars subequal in size; teeth on lacina mobilis 3; palp absent. Maxilla 1, inner plate triangular and roundish; without setae; outer plate truncate terminally; outer plate with 9 spines; palp longer than outer plate; palp truncate distally; palp truncate distally, with several distal teeth. Upper lip, apical margin slightly concave with fine bristles. Maxilla 2, inner plate slightly shorter than outer plate; strongly setose marginally; outer plate with 6–7 stiff setae terminally. Maxilliped, palp segment 4 present; subequal to outer plate; outer plate inner margin with 6–9 spines and with spines and setae on distal third.

Thoracic appendages. Gnathopod 1, coxa rounded anterodistally; coxa, very small, subovate with 2 anterodistal setae; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis with sparse setae on posterior margin; carpus with anterodistal setae and with long setae on posterior margin; carpus subequal to propodus; propodus twice as long as wide and ovate; propodus subequal to carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm transverse, finely serrate and subequal to dactyl; dactyl slightly curved. Gnathopod 2, coxa anterior margin with small triangular tooth produced downward and posteroventral margin rounded; basis with anteromarginal setae and subequal to basis of gnathopod1; merus less than half length of carpus; propodus shorter than carpus; palm short; dactyl hook-like. Pereopods 3–7, basis sublinear; prehensile or parachelate. Pereopods 3 and 4, carpus shorter than propodus. Pereopod 3, anteroventral margin of coxa rounded anteroventrally; process of coxa produced and bluntly rounded. Pereopod 7, dactyl less than half length of carpus. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; 2, acuminate and ventral margin with 2–3 short, curved spines; 3, posteroventral margin acuminate.

Abdominal appendages. Urosomite 1, dorsal margin dorsal keel with acute posterior process. Uropod 1, shorter than uropod 3; peduncle with two proximomedial spines and one distal spine; rami subequal; peduncle shorter than rami. Uropod 2, shorter than uropod 1; peduncle equal to outer ramus in length; outer ramus subequal to inner ramus; inner margin of inner ramus with 1 or 2 proximal spines and outer margin of outer ramus with 4–5 spines. Uropod 3, outer ramus, outer margin spinose; inner ramus longer than outer ramus; rami longer than peduncle and longer than uropod 1 and telson; outer ramus shorter than inner. Telson, broadest proximally; length more than twice width; cleft at least 90 percent to base; equal to rami of uropod 3; lateral setation present; with 2–3 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Unknown

Depth occurrence. Unknown

Distribution. Shijiki Bay, Japan.

Remarks. Hirayama (1984) described this species as a subspecies of *Polycheria atolli* Walker, 1905. Bousfield and Kendall (1994) elevated it to full species rank in a study comparing the morphological characters of Northwest Pacific species and East Pacific species of *Polycheria.* It can be separated from the other Sea of Japan species (*P. amakusaensis* and *P. japonica*) by the acute posteroventral angle of epimeral plate 1. *Polycheria orientalis* and *P. amakusaensis* are distinguished from *P. japonica* by their very short palms of the dactyls on gnathopod 1-2 that creates a nearly chelate rather than subchelate condition.

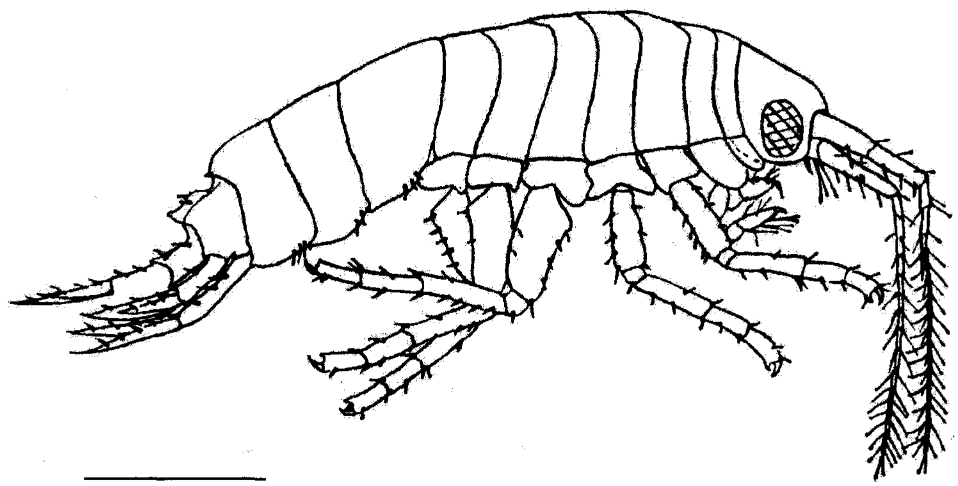

Figure 37 - *Polycheria orientalis* Hirayama, 1984.♀, 4.5 mm, West Kyushu, Japan. Modified from Hirayama, 1984. Whole animal. Scale = 1.0 mm.

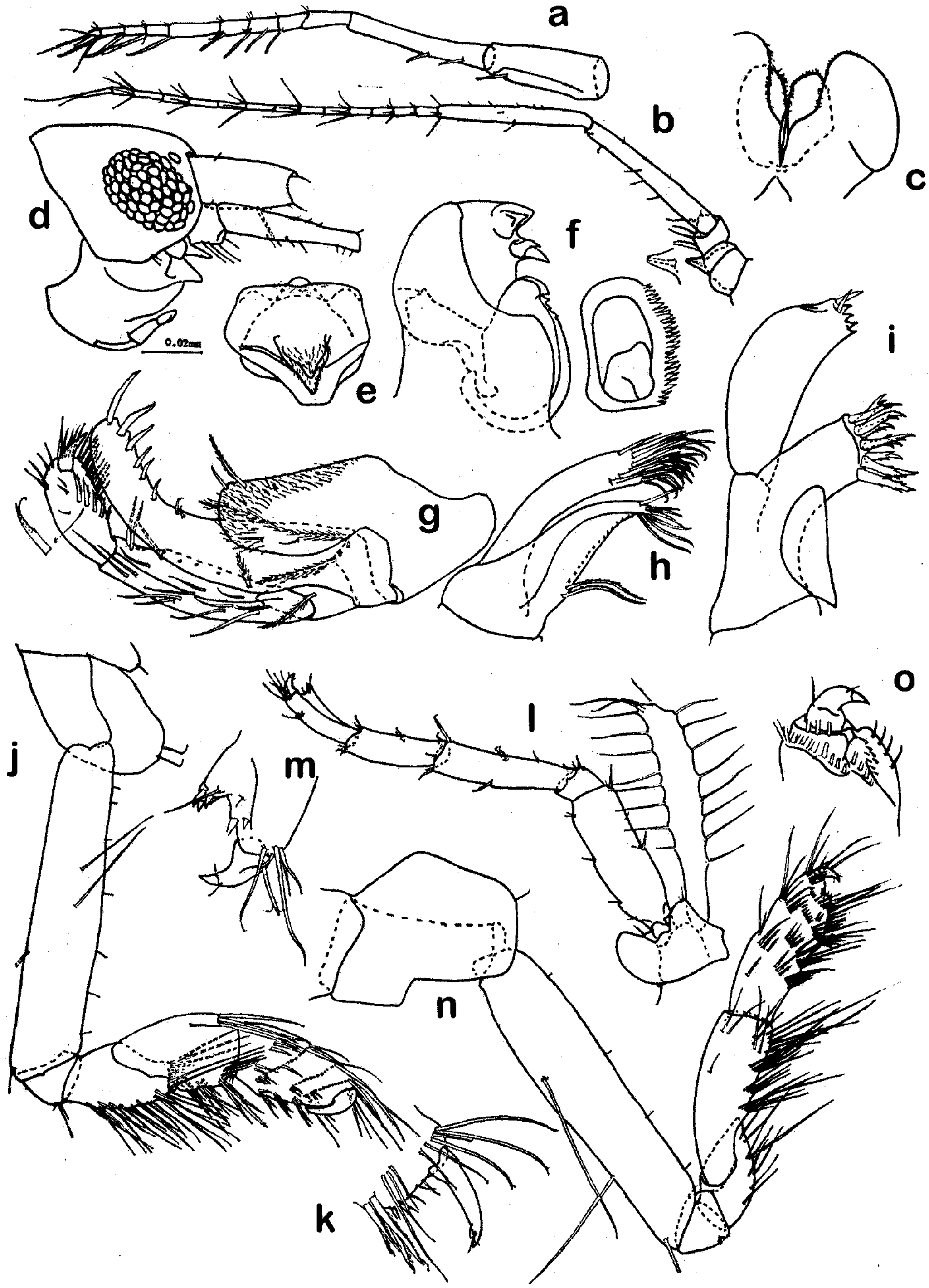

Figure 38 - *Polycheria orientalis* Hirayama, 1984. ♀, 4.5 mm, West Kyushu Japan. Modified from Hirayama, 1984. a, antenna 1; b, antenna 2; c, lower lip; d, head; e, upper lip; f, mandible; g, maxilliped; h, maxilla 2; i, maxilla 1; j, gnathopod 1; k, gnathopod 1, detail; l, pereopod 3; m, pereopod 3, detail; n, gnathopod 2; o, gnathopod 2, detail.

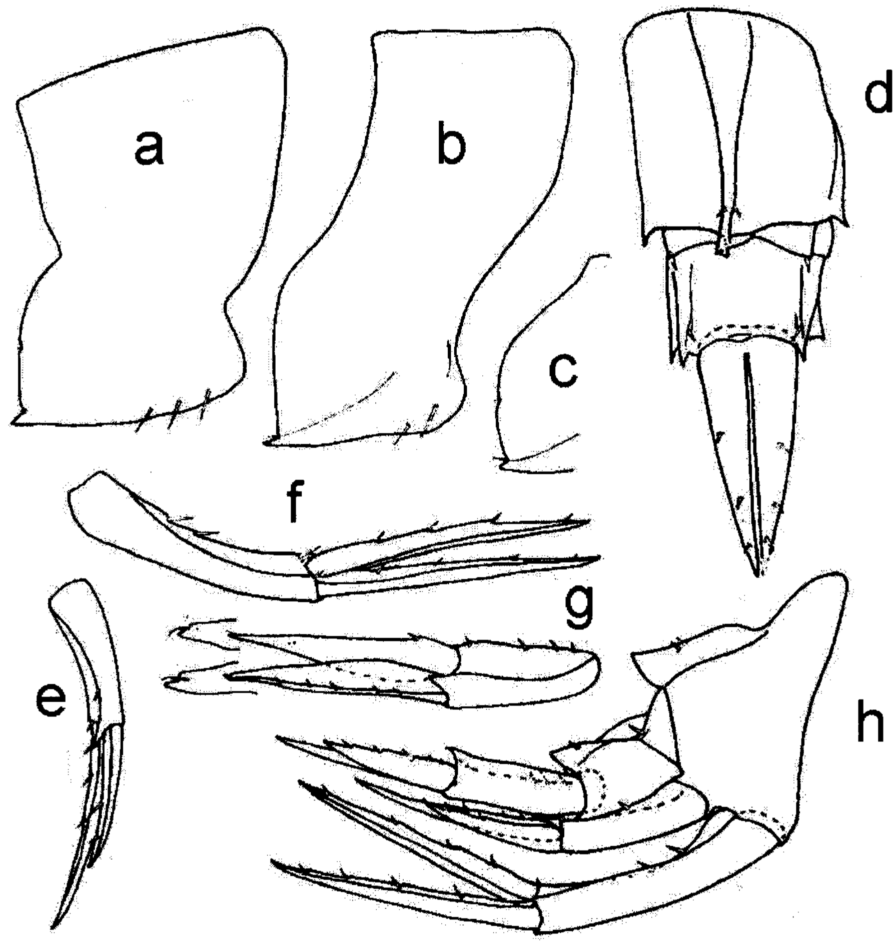

Figure 39 - *Polycheria orientalis* Hirayama, 1984. ♀, 4.5 mm, West Kyushu, Japan. Modified from Hirayama, 1984. a, epimeral plate 3; b, epimeral plate 2; c, epimeral plate 1; d, telson with urosomites 2-3; e, uropod 2; f, uropod 1; g, uropod 3; h, lateral view of urosome.

Polycheria tenuipes Haswell

Figure 40-43

Synonyms. Polycheria tenuipes Haswell, 1879: 345, fig. 8, pl. 12; Haswell, 1882: 262; Stebbing, 1888: 945, pl. 83; Stebbing, 1906: 520; Stebbing, 1910: 644; Schellenberg, 1931: 221, fig. 107 f-g; Barnard, 1958: 39; Barnard, 1969a: 200; Barnard, 1970: 167; Sanderson, 1973: 10; Thurston, 1974b: 18; Lowry and Bullock, 1976: 272; Barnard and Karaman, 1991: 271-272; Debroyer and Jazdzewski, 1993: 38.

Materials. 5 ♂♂ AM-P-36703, Mungano Point, Twofold Bay, New South Wales, Australia, depth 12 m, subtidal wharf piles, 19 December 1985, 37°6.2'S 149°55.7'E, det. J.K. Lowry; 1 ♂ AM-P-6692, Coff's Harbour jetty, Coff's Harbour, New South Wales, Australia, depth 8 m, on *Pyura praeputialis* on jetty pilings, 9 March 1992, 30°18.45'S 153°85' E, det. R.T. Springthorpe; 1 ♀, 4.0 mm (illustrated), 2 ♂♂, 2 ovigerous ♀♀, 1 juvenile, AM-P-57218, Coff's Harbour jetty, Coff's Harbour, New South Wales, Australia, depth 6 m, with worm tubes encrusted with sponges on jetty pilings, 9 March 1992, 30° 18.4'S 153°10.8'E, det. R.T. Springthorpe; 1 ♂, 1 ♀, 2 1 juvenile, AM-P-56691, 50 m west of Split Solitary Island, New South Wales, Australia, depth 17 m, associated with *Herdemania momus*, rocks, sponges, and ascidians, 7 March 1992, 30° 14.0'S 153° 10.8'E, coll. S. Keagle, det. R.T. Springthorpe.

Type locality. Port Jackson, New South Wales, Australia

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–2 combined. Eye, one third of width head; eye rounded oval; eye reddish brown with a whitish coating. Rostrum minute. Antenna 1, longer than half length of body and subequal to antenna 2; peduncle segment 1 short and stout, segment 2 less stout, or 3 equal to first flagellar segment, shorter than segment 2; flagellum with 10–20 articles. Antenna 2, about one-half body length; peduncle articles 2 and 3 narrow, subequal, article 1 short and stout and article 5 shorter than 4; flagellum with 14–15 segments and subequal to peduncle. Mandible, spine row 2–3; molars triturative; palp absent. Maxilla 1, outer plate truncate terminally; with 11 spines; palp longer than outer plate; palp expanded distally; palp truncate distally, with several distal teeth. Lower lip, outer lobe projecting laterally. Upper lip, apical margin broadly rounded with fine lateral and facial setae. Maxilla 2, inner plate subequal to outer plate; with 12–14 marginal spines on distal half; outer plate with dense terminal setae. Maxilliped, palp segment 4 present; exceeding outer plate; length less than width of segment 3; outer plate inner margin with 6–9 spines; inner plate one-third length of outer plate; outer plate reaching middle of palp segment 3; inner plate with short, fine terminal setae and with 2 short distal spines.

Thoracic appendages. Gnathopod 1, coxa, distally rounded, deeper than wide; basis widened distally; basis anterior margin with several long setae and posterodistal margin with 2–3 long setae; carpus with anterodistal setae; carpus longer than propodus; propodus short and deep, width 60% of length and ovate; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm subequal to dactyl; dactyl slightly curved. Gnathopod 2, coxa with a small acute process that the anteroventral margin; basis with anteromarginal setae, with posterodistal setae, with posteromarginal setae, and longer than basis of gnathopod 1; merus half length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus oblong, three times as long as broad; palm short, poorly defined; dactyl subequal to palm. Pereopods 3–7, basis sublinear; carpus longer than propodus; prehensile or parachelate; propodus not widened distally; coxal gills weakly pleated. Pereopods 3 and 4, carpus longer than propodus. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa short, twice as long as its basal width; posteroventral margin of coxa rounded; basis with anterodistal and posterodistal spines and anterior and posterior margins spinose; merus shorter than basis, longer than carpus and propodus combined; merus with several large posteromarginal spines and posterodistal spines; carpus longer than propodus; carpus with 2 posteromarginal spines and 2 posterodistal spines; propodus with anterodistal setae, with 1 large curved spine at posterodistal projection, and with 3 anterior marginal spines; palm of propodus with 1 medial spine and deeply recessed, subtriangular. Pereopod 4, coxa anteroventral and posteroventral margins bluntly produced; Pereopod 4, basis with 2 posterodistal spines and with anteromarginal spines and setae; merus longer than propodus; merus with 1 posterodistal spine and with 1–2 posteromarginal spine. Pereopod 5, coxa, anteroventral margin slightly produced and posterior margin rounded; basis expanded proximally and longer than merus, with posterior lobe at base; basis with 10 slender posteromarginal spines; merus longer than carpus and propodus combined; merus with 1 very long anterodistal spine and with 1 very long posterodistal spine; carpus longer than propodus; carpus with 3 long anterodistal spines and with 3 anteromarginal spines; propodus with 1 long anterodistal spine, with 2–3 anteromarginal spines, palm with a short, thick medial spine, and with a large curved posterodistal spine. Pereopod 6, coxa ventral angles rounded and ventral margin irregular; basis with a posterior proximal knob and longer than merus; basis with

1 anterodistal spine; merus with 1 posterodistal spine, with 3 short anterior marginal spines and 3 long stiff setae, and with anterodistal spines; carpus with 1 long anterodistal spine and with 3 anteromarginal spines; propodus palm with short, thick medial spine, with 2 anterodistal spines, with 2–3 anteromarginal spines, with 1 large curved spine at posterodistal projection, and with anterodistal setae. Pereopod 7, coxa anteroventral angle rounded, rounded posteriorly, and similar in shape to coxa 5 and 6 but smaller; basis with 4–5 anteromarginal spines, with 2–3 small posteromarginal spines, and posterodistal setae; merus longer than basis and subequal to carpus and propodus combined; merus with 2–3 long anterodistal and posterodistal spines; carpus with 1 anteromarginal spine, with anterodistal and posterodistal spines, and with 1 long posteromarginal spine; dactyl less than half length of carpus; propodus produced posterodistally with 1 long curved spine, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, ventral margin with 3–4 slender spines and posteroventral angle with a small, triangular tooth; 2, posteroventral angle with a small triangular tooth and ventral margin with 3–4 slender spines; epimera 2 and 3, anteroventral margin without setae; 3, posteroventral margin with a small triangular tooth; 3, ventral margin with 3–4 slender spines. Urosomite 1, posteroventral margin without setae.

Abdominal appendages. Urosomite 1, dorsal margin with a proximal saddle-shaped concavity and dorsal keel with acute posterior process. Urosomites 2–3, fused, with no dorsal saddle shaped indentation and sharply keeled dorsally and doroslaterally; 2 and 3, with 1 proximal spine; urosomite 2–3, dorsolateral margins forming keels, running out to form acute lobes. Uropod 1, subequal to uropod 3; peduncle with a large, curved distolateral spine and with 3 elongate ventral setae; rami subequal; peduncle much shorter than outer ramus; rami outer ramus with dorsolateral spines and inner ramus with 1 apical spine. Uropod 2, shorter than uropod 1; peduncle with strong distolateral spines and equal to outer ramus in length; inner ramus shorter than outer ramus; outer ramus shorter than inner; outer margin of outer ramus with 4–5 spines. Uropod 3, peduncle shorter than rami; with a short, distal spine on dorsal margin; rami wide proximally, tapering to apices; inner ramus with 4 dorsolateral spines and outer ramus with 4 dorsolateral spines; inner ramus longer than outer ramus. Telson, broadest medially; cleft at least 90 percent to base; equal to rami of uropod 3; lateral setation present; with 2–3 lateral spines; apical spines absent.

Habitat. Among shells and stones, associated with compound ascidians and sponges.

Depth occurrence. 16 m.

Distribution. Southeastern Australia; Falkland Islands, Barkley Sound, Calbuco.

Remarks. Polycheria tenuipes is the type species of the genus. Several papers (Holman and Watling, 1983, for example) have suggested the type species to be *Dexamine antarctica* based upon the synonymy of Chilton (1912). This was reported in Barnard, 1969c, however, the type species was selected as *Polycheria tenuipes* by Barnard, 1969a.

Polycheria tenuipes is a typical member of the Indo-West Pacific/Australia group of the genus in that it possesses coxal plates with reduced anteroventral processes and a distally widened palp of maxilla 1. This particular species has bright red eyes, the color often persistent in alcohol preservation.

Haswell (1979) provided no information on habitat or associated organisms, only the depth of occurrence (3 m). Schellenberg (1931) recorded the species at the Falkland Islands in the South Atlantic Ocean, a rather long distance from the type locality, and changed its status to *Polycheria antarctica* form *tenuipes.* He stated that the form was not equivalent to any of the forms described from the Southern Ocean or South Atlantic. Schellenberg (1931) no doubt widened the definition of the species because at the time because the synonymy of Chilton (1912) held *Dexamine antarctica* to be the type species (see Chapter 2 for more information on the history of the genus). The Falkland Island material was not available for study, but it is quite likely it represents a new species or a variant of one of the South Atlantic/Southern Ocean forms described by Schellenberg (1931). In this report, *Polycheria tenuipes* is considered to be of full species rank.

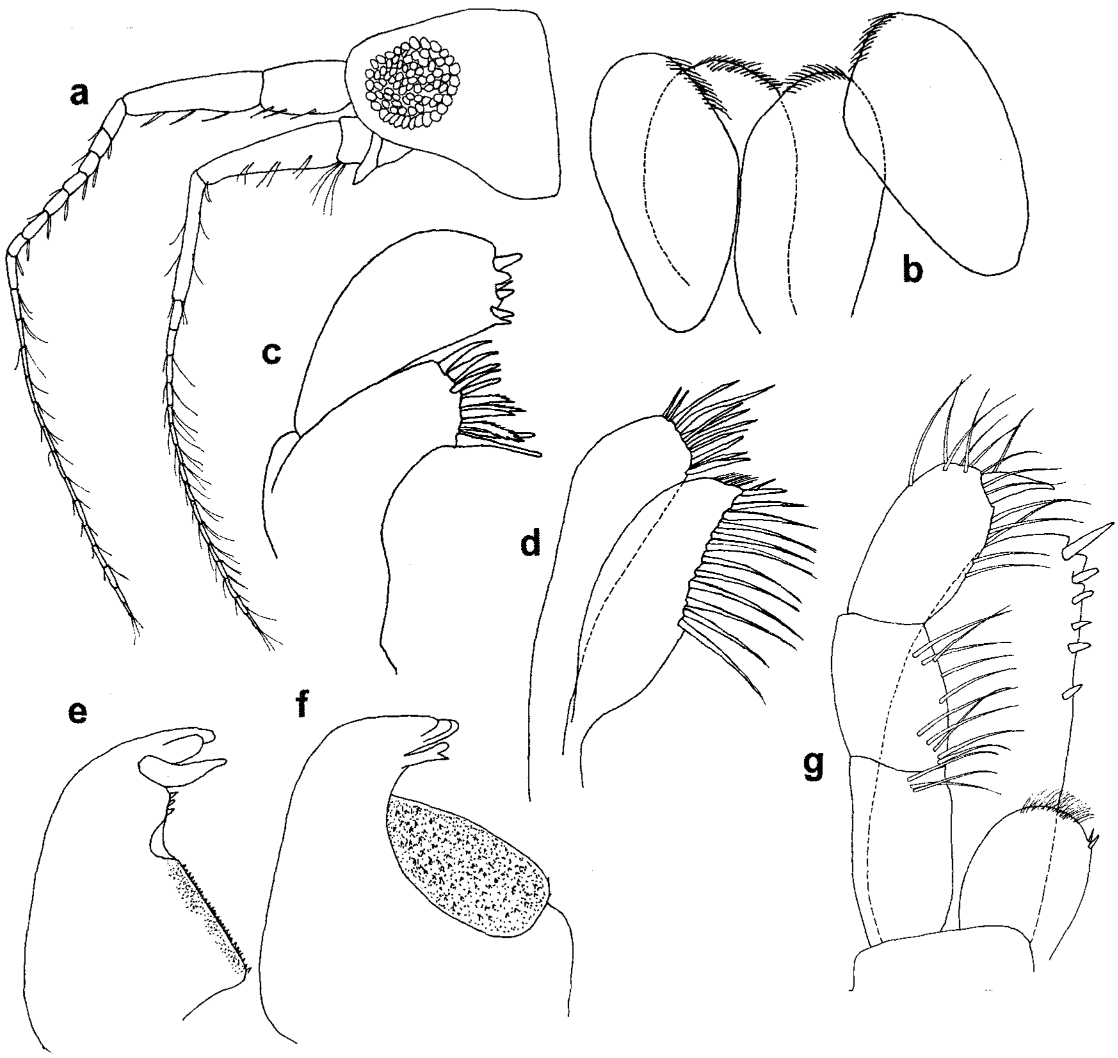

Figure 40 - *Polycheria tenuipes* Haswell, 1879. ♀, 4.0 mm, AM-P- 57218, Coff's Harbour, New South Wales, Australia. a, head and antenna 1-2; b, lower lip; c, maxilla 1; d, maxilla 2; e, left mandible; f, right mandible; g, maxilliped.

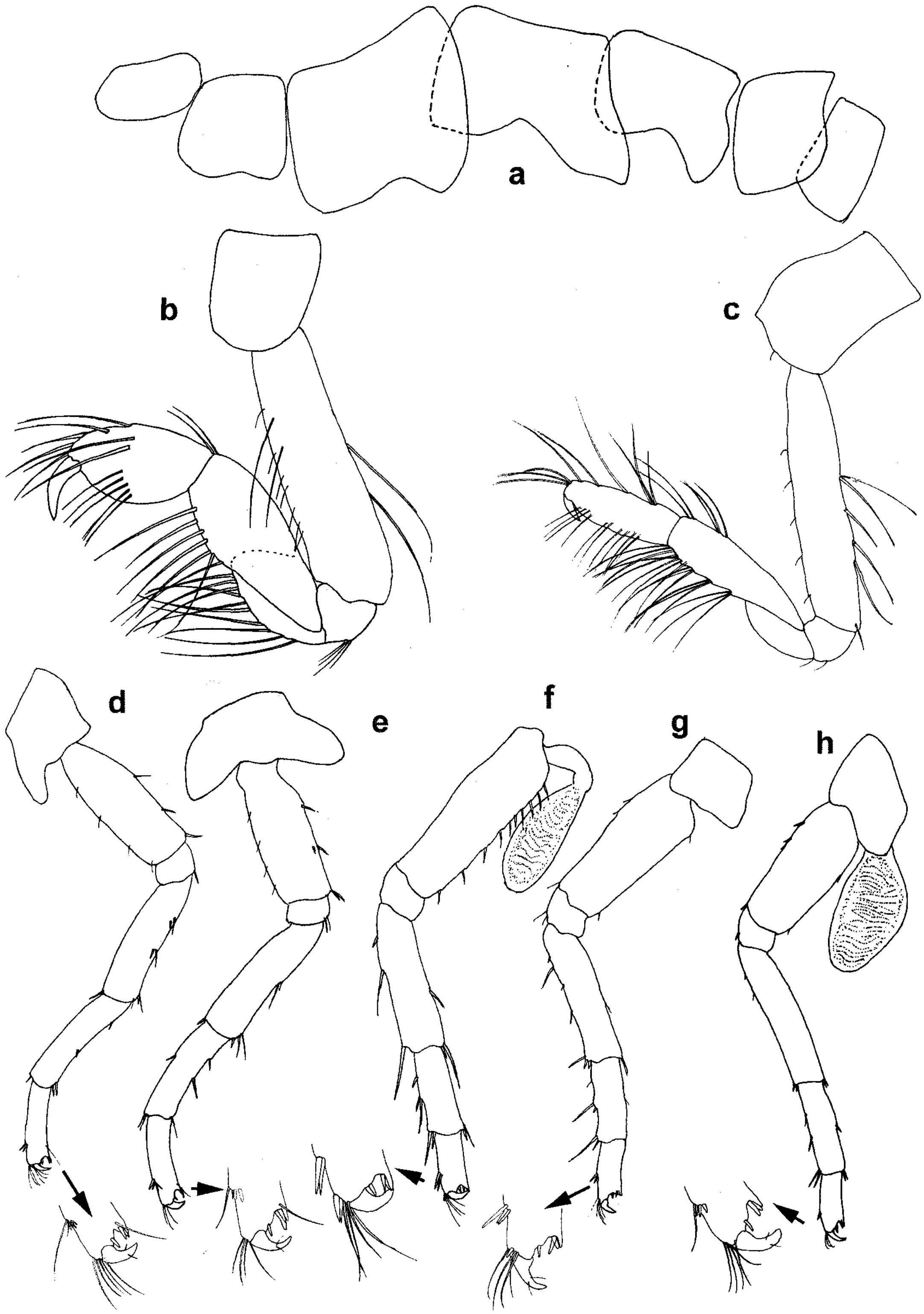

Figure 41 - *Polycheria tenuipes* Haswell, 1879. ♀, 4.0 mm, AM-P- 57218, Coff's Harbour, New South Wales, Australia. a, coxal plates 1-7 (right to left); b, gnathopod 1; c, gnathopod 2; d, pereopod 3; e, pereopod 4; f, pereopod 5; g, pereopod 6; h, pereopod 7.

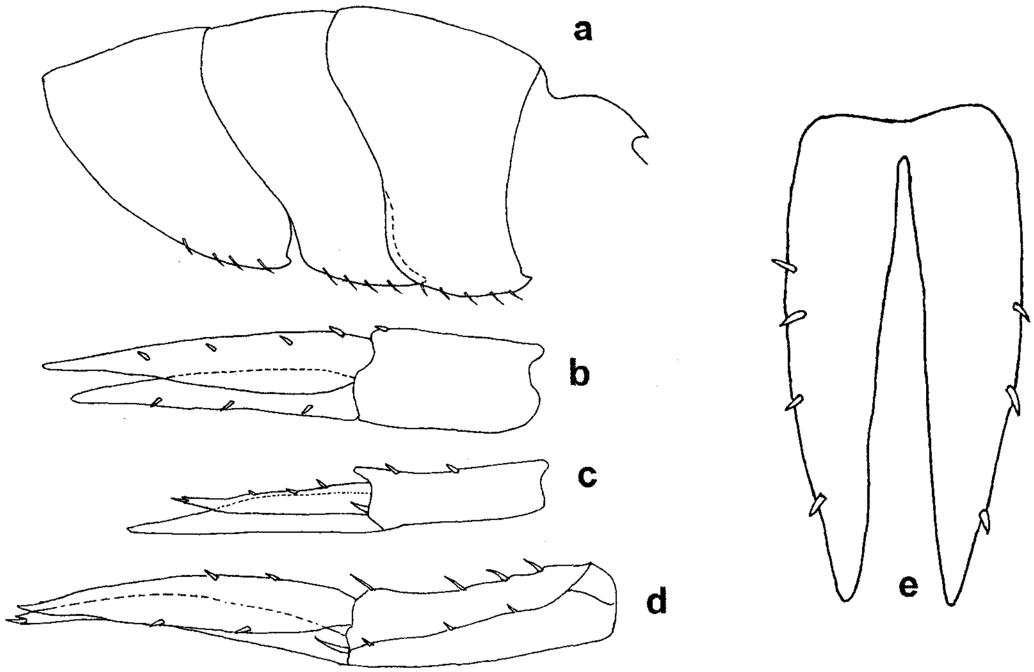

Figure 42 - *Polycheria tenuipes* Haswell, 1879. ♀ 4.0 mm, AM-P- 57218, Coff's Harbour, New South Wales, Australia. a, pleosome; b, uropod 3; c, uropod 2; d, uropod 1; e, telson.

Polycheria sp. E, new species

Figure 43-45

Materials. Holotype - 1 ovigerous ♀, 4.5 mm (illustrated), paratypes - 2 ♂♂, 3 ovigerous ♀♀, 10 ♀♀, 1 juvenile, Kri Island, Raja Ampat, Indonesia, 00° 33.319'S 130° 40.653'E, rubble wash of reef crests 200 meters south of Kri Eco Resort Dock, depth 1-3 m, 24 November 2007, coll. J.D. Thomas.

Type locality. Kri Island, Raja Ampat, Indonesia

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–2 combined. Eye, less than half width of head; eye rounded oval; eye light brown in alcohol. Rostrum absent. Antenna 1, subequal to antenna 2; peduncle segment 1 short and stout, segment 2 less stout and 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, equal to antenna 1; peduncle articles 4 and 5 equal; flagellum shorter than peduncle, with 10–11 segments. Mandible, spine row 2–3; molars triturative; palp absent. Maxilla 1, inner plate apex rounded; with one terminal seta; outer plate truncate terminally; outer plate with 10 spines; palp longer than outer plate; palp expanded distally; palp truncate distally, with several distal teeth. Lower lip, outer lobe projecting laterally. Upper lip, apical margin broadly rounded with fine lateral and facial setae. Maxilla 2, inner plate subequal to outer plate; with 6 terminal spines and strongly setose marginally; outer plate with dense terminal setae. Maxilliped, palp segment 4 present; exceeding outer plate; length equal to width of palp segment 3; outer plate inner marginal spines with 1–5 spines; inner plate greater than one-third length of outer plate; outer plate reaching distal margin of palp segment 3; inner plate with short, fine terminal setae and with 1–2 spines.

Thoracic appendages. Gnathopod 1, coxa, anteroventral angle produced; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anterior margin with several long setae, with 7 stiff setae on anterior margin, and posterodistal margin with 2–3 long setae; carpus with anterodistal setae and with long setae on posterior margin; carpus longer than propodus; propodus subovate; propodus anterior and posterior margins with long simple and plumose setae; males without deep notch on anterior margin; palm extremely short, undefined; dactyl short, strongly curved. Gnathopod 2, coxa subrectangular with distal angles rounded; basis with anteromarginal setae, with posteromarginal setae, and subequal to basis of gnathopod1; merus less than half length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus broad distally and half as wide as long; palm broadly convex; dactyl subequal to palm. Pereopods 3–7, basis sublinear; prehensile or parachelate; coxal gills weakly pleated. Pereopods 3 and 4, carpus longer than propodus. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa produced anteroventrally to blunt tooth; process of coxa broad, as long as broad and produced and bluntly rounded; posteroventral margin of coxa acuminate or acute; basis constricted proximally and with anterodistal and posterodistal spines; merus longer than propodus; merus with anteromarginal and posteromarginal setae, with 1 posterodistal spine, and with anterodistal seta; carpus longer than propodus; carpus with 2 posteromarginal spines and 2 posterodistal spines and posterodistal and anterodistal margins with short spines; propodus posterior margin produced, with 2–3 distal spines and with 3 anterior marginal spines; palm of propodus not deeply recessed and with 1 medial spine. Pereopod 4, coxa anteroventral margin produced into blunt tooth, posteroventral margin rounded; Pereopod

4, basis with 1 posterodistal spine and with posteromarginal spines; merus subequal to basis; merus with 2 long posterodistal spines and with 2 or 3 short posterior setae and a long anterodistal spine. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis subequal to basis and not expanded proximally; basis with 10 slender posteromarginal spines and with long anteromarginal and posteromarginal setae; merus equal to carpus and propodus combined; merus with 2 posterodistal spines; carpus longer than propodus; carpus with 3 strong anterodistal spines, with 3 long anterodistal spines, and with 2 posteromarginal spines; propodus with 2 posterodistal spines, with 2–3 anteromarginal spines, and palm with a short, thick medial spine. Pereopod 6, coxa wider than long and with small, rounded anteroventral lobe; basis widened proximally; basis with several proximal anteromarginal setae, with 1 anterodistal spine, and with 1 posterodistal subdistal spine; merus with 1 posterodistal spine, with 3–4 anterior marginal spines, and with anterodistal spines; carpus with 3 anteromarginal spines and with anterodistal and posterodistal spines; propodus palm with short, thick medial spine, with 2–3 anteromarginal spines, and posterior margin produced with 2–3 spines. Pereopod 7, coxa similar in shape to coxa 5 and 6 but smaller; pereopods 5 and 7, carpus longer than propodus; basis with posterodistal and anterodistal spines, with 2–3 small posteromarginal spines, and linear; merus shorter than basis; merus with a single, long posteromarginal spine, with 4 anteromarginal spines, and with a strong anterodistal spine; carpus with 1 anteromarginal spine and with anterodistal and posterodistal spines; propodus produced distally with 2–3 spines, with 2–3 anterior spines, and palm with short, strong distomedial spine. Epimeral plate 1, posteroventral angle with a small, triangular tooth; 2, posteroventral angle with a small triangular tooth; epimera 2 and 3, ventral margins with sparse, slender setae; 3, posteroventral margin with a small triangular tooth; 3, ventral margin with 3–4 slender setae.

Abdominal appendages. Urosomite 1, dorsal margin with a proximal saddle-shaped concavity, extended posteriorly to mask part of urosomite 2–3, and strongly produced posteriorly to form blunt process. Urosomites 2–3, fused with a mid-dorsal saddle-shaped indentation; 2 and 3, dorsal margins of lobes with a proximal and distal spine; urosomite 2–3, dorsolateral margins forming keels, running out to form acute lobes. Uropod 1, longer than uropod 3; peduncle with a long, curved interramal spine and lacking marginal setae; rami subequal; peduncle shorter than rami; rami with apical spines, outer ramus with dorsolateral spines, and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle shorter than rami with a strong distomedial spine; inner ramus longer than peduncle; outer ramus shorter than inner; rami without apical spines, inner margin of inner ramus with 1 or 2 proximal spines, and outer margin of outer ramus with 4–5 spines. Uropod 3, peduncle shorter than rami; with 2 distal spines; rami wide proximally, tapering to apices; outer ramus with 6–8 spines; inner ramus exceeding the length of the telson, twice length of peduncle, and longer than outer ramus; outer ramus shorter than inner. Telson, triangular, acute distally and broadest proximally; half as broad as long; cleft about 80 percent to base; two thirds length of uropod 3; lateral setation present; with 2–3 lateral spines; apical spines absent.

Habitat. Reef rubble, associated with sponges and tunicates.

Depth occurrence. 1-3 m.

Distribution. Kri Islands, Raja Ampat archipelago, Indonesia

Remarks. This species is the first described from the Indonesian region, although the numerous potential habitats for *Polycheria* suggest the likelihood of several new species from that region. Barnard (1976) proposed that the diverse habitats found in the tropical Indo-Pacific, might yield, with the study of inquilinous species, very rewarding results. The nearest described species of *Polycheria* to the type locality of species E is from Lizard Island in the Great Barrier Reef system of Australia (S. LeCroy, pers. comm.). Material from Madang Lagoon in Papua, New Guinea, located between Raja Ampat and Lizard Island, is available but yet to be examined. Whether the tropical Indo-Pacific is an area of evolutionary innovation, as suggested by Barnard (1976), awaits further examination of the existing material and collecting efforts in other parts of the region.

Polycheria sp. E falls into Group I of Schellenberg (1931) as it possesses a rounded posteroventral margin of coxal plate 4. In the 50% majority rule consensus tree generated from characters of species and forms in this report (Chapter 5), this species is most closely related to the type species of the genus *Polycheria tenuipes* Haswell, 1979 from the east coast of Australia.

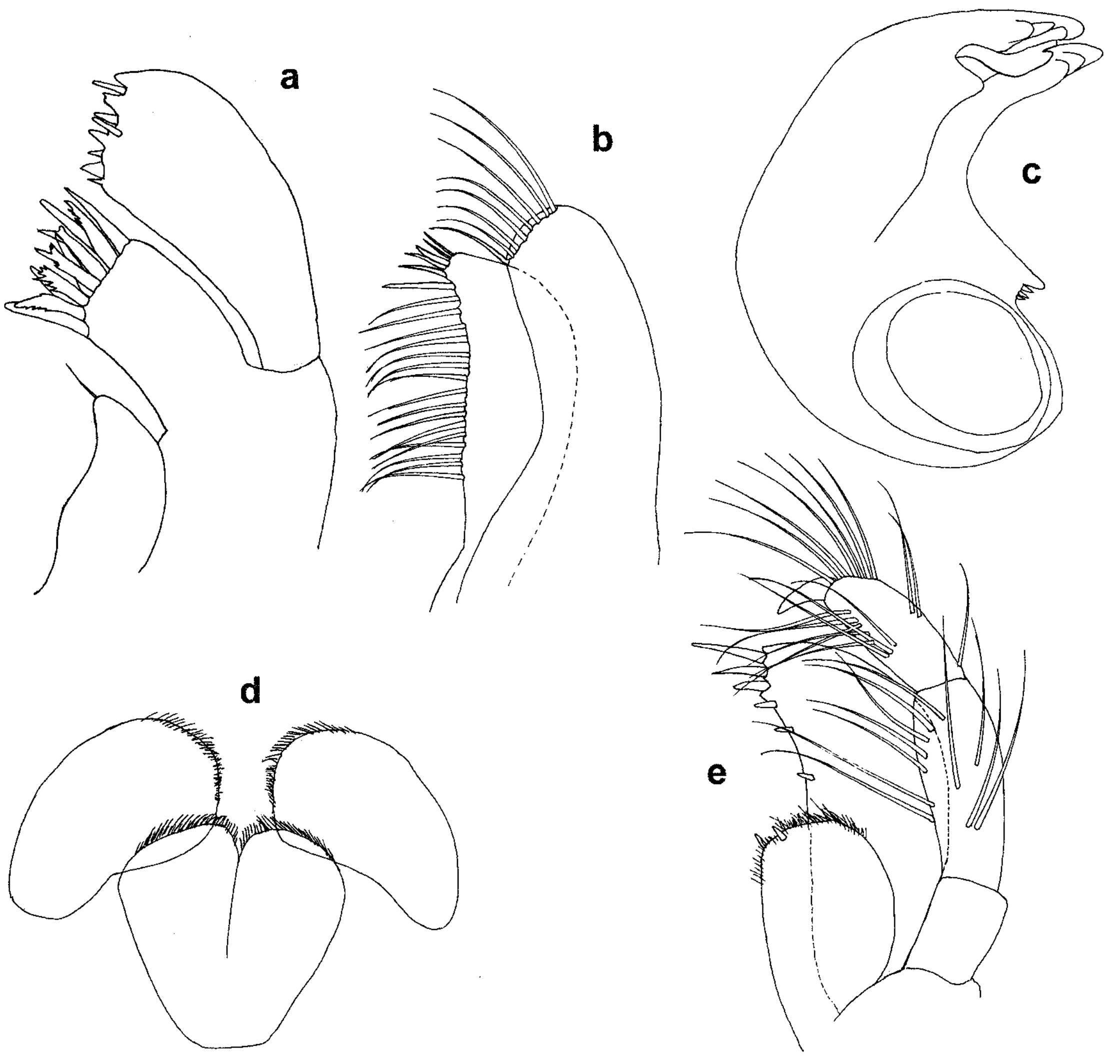

Figure 43 - *Polycheria* sp. E, new species. Ovigerous ♀, 4.5 mm, USNM 000000, Kri Island, Raja Ampat, Indonesia. a, maxilla 1; b, maxilla 2; c, mandible; d, lower lip; e, maxilliped.

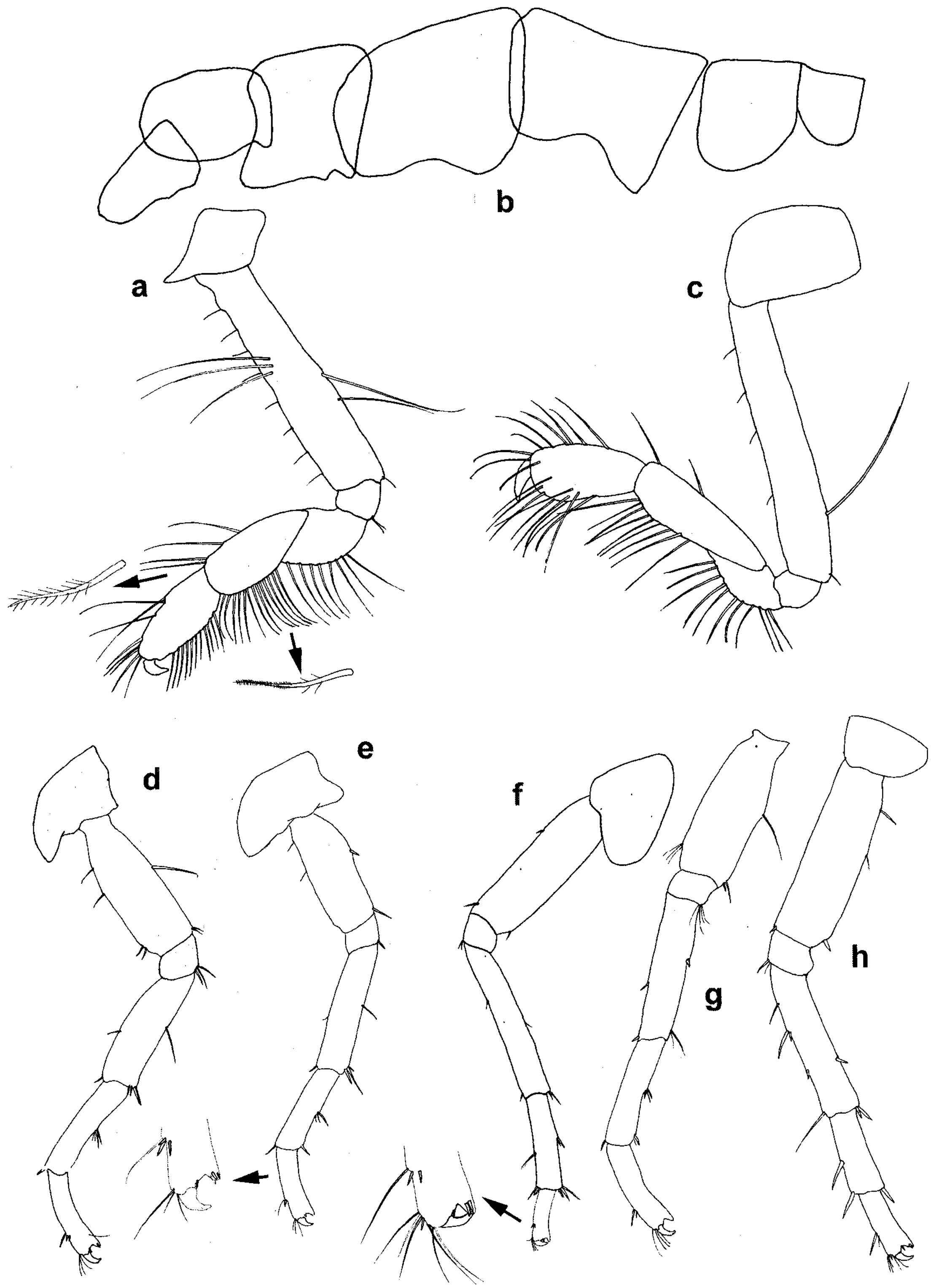

Figure 44 - *Polycheria* sp. E, new species. Ovigerous ♀, 4.5 mm, USNM 000000, Kri Island, Raja Ampat, Indonesia. a, gnathopod 1 with detail of setae; b, coxal plate 1-7 (right to left); c, gnathopod 2; d, pereopod 3; pereopod 4 with detail of propodus; f, pereopod 5 with detail of propodus; g, pereopod 6; pereopod 7.

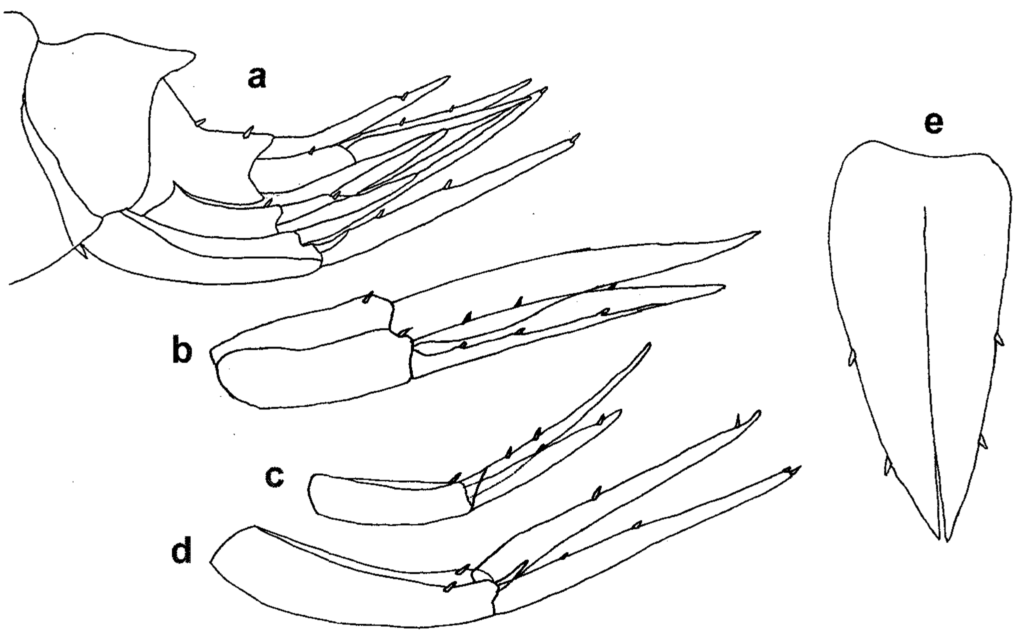

Figure 45 - *Polycheria* sp. E, new species. Ovigerous ♀, 4.5 mm, USNM 000000, Kri Island, Raja Ampat, Indonesia. a, urosome; b, uropod 3; c, uropod 2; d, uropod 1; e, telson.

Northeast Pacific Ocean species

Polycheria carinata Bousfield and Kendall

Figure 46

Synonyms. Polycheria carinata- Bousfield and Kendall, 1994: 42, fig. 21.

Materials. Type material not examined, description based on Bousfield and Kendall, 1994. Type species ♀, 4.0 mm, CMN-NMCC 1994-0390, McCaulay Point, Victoria, British Columbia, from ascidians and sponges beneath boulders, 25 July 1975, coll. G. O'Connel (Bousfield and Kendall, 1994).

Type locality. McCaulay Point, Victoria, British Columbia.

Description. Head appendages. Head, anteroventral margin rounded or obtuse. Eye, one half width of head; eye ovate. Rostrum minute. Antenna 1, subequal to antenna 2; peduncle segment 1 shorter than segment 2. Antenna 2, equal to antenna 1; peduncle articles 4 and 5 equal; flagellum subequal to peduncle. Mandible, palp absent. Maxilla 1, inner plate apex rounded; outer plate with 7 spines; palp longer than outer plate; palp bluntly acuminate distally. Maxilla 2, inner plate with sparse inner marginal setae; outer plate with terminal plumed setae. Maxilliped, palp segment 4 present; shorter than outer plate; outer plate inner margin with 10–12 spines; inner plate one-third length of outer plate; inner plate with plumed terminal setae.

Thoracic appendages. Gnathopod 1, coxa acute anteriorly; coxa, anteroventral angle produced; basis sublinear, equal to merus, carpus, and propodus combined; basis with sparse setae on anterior margin; carpus with facial and posteromarginal setae; carpus longer than propodus; propodus narrowed at base; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males without deep notch on anterior margin; palm shorter than dactyl. Gnathopod 2, basis with posteromarginal setae; propodus subequal to carpus. Pereopods 3–7, basis broader than distal segments; prehensile or parachelate. Pereopods 3 and 4, carpus shorter than propodus. Pereopod 3, anteroventral margin of coxa produced anteriorly into sharp tooth. Pereopod 4, anteroventral angle of coxa broadly rounded. Pereopods 5 and 7, carpus shorter than propodus; pereopod 7, dactyl less than half length of carpus. Epimeral plate 2, squarish; 3, posteroventral margin squared.

Abdominal appendages. Urosomite 1, dorsal margin low, not produced posteriorly. Urosomites 2–3, sharply keeled dorsally and dorsolaterally. Uropod 1, peduncle fringed with ventral setae; rami subequal. Uropod 2, shorter than uropod 1; peduncle less than half length of inner ramus; rami with short apical spines. Uropod 3, outer margin of outer ramus with 1–3 short spines; inner ramus longer than outer ramus; inner ramus greater than twice the length of peduncle and longer than uropod 1 and telson; outer ramus three-fourths length of inner ramus. Telson, broadest proximally; less than half as long as broad; cleft about 80 percent to base; attaining middle of uropod 3; lateral setation present; with 4–6 lateral spines; apical spines absent; apical spines equal to marginal spines.

Habitat. From ascidians and sponges beneath boulders.

Distribution. Southern Vancouver Island north to Central British Columbia coast

Remarks. This species is very similar to *P. mixillae,* the type localities are within 400 km of each other. *Polycheria carinata* is separated from *P. mixillae* by the presence of strong posterior setae on peduncle segment 2 and the flagellum of antenna 1 and much stronger anteroventral process on coxal plate 3. It differs from *P. osborni,* another species whose northern range overlaps that of *P. carinata,* by it slightly larger eyes and shorter dactyl of gnathopod 1, extending less than 50% of the length of the palm. *Polycheria osborni* has been reported, throughout its range, with more marginal spines on the telson than either *P. carinata* or *P. mixillae* (Bousfield and Kendall, 1994). No records of this species have been located outside Vancouver Island.

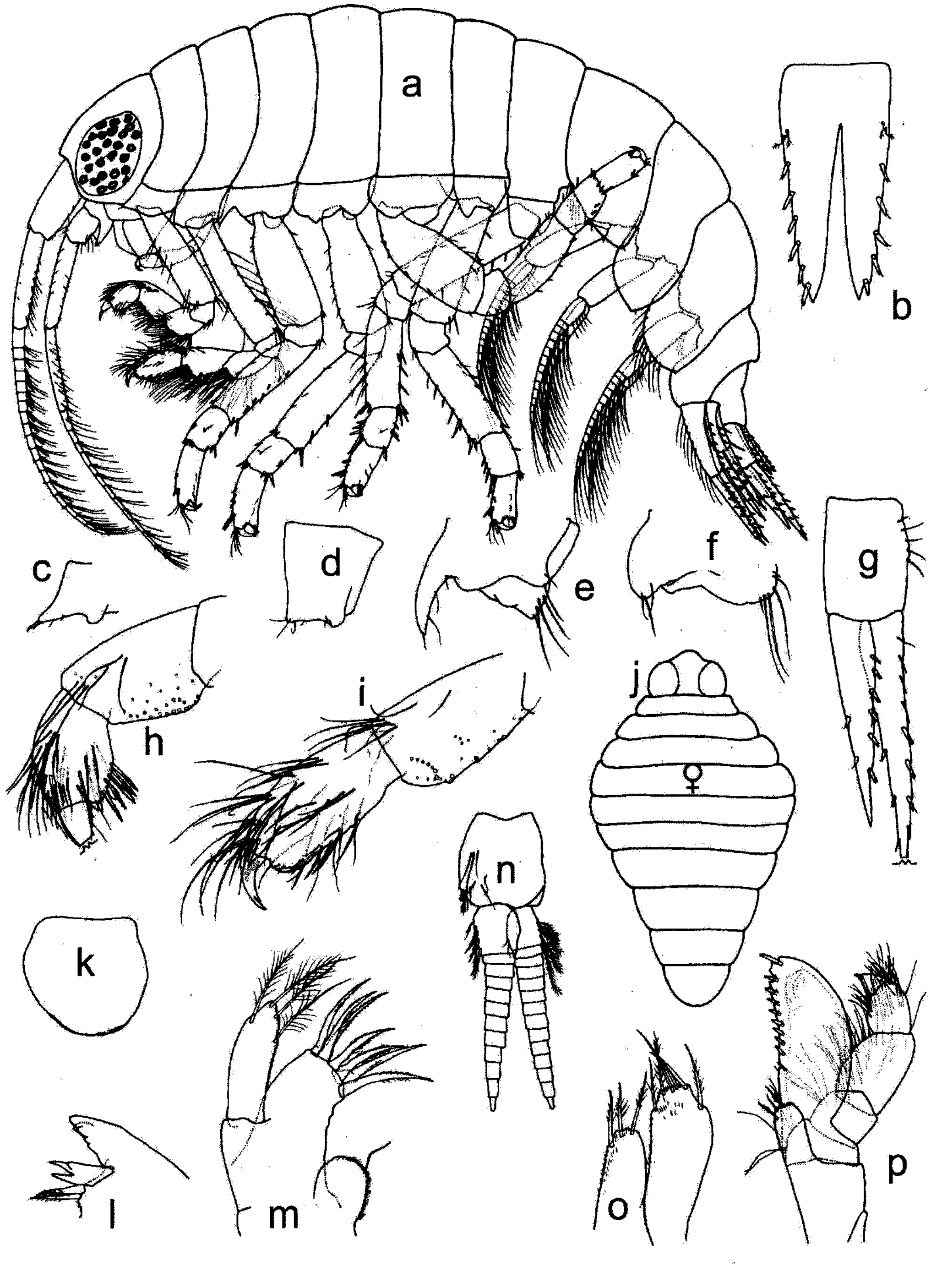

Figure 46 – *Polycheria carinata* Bousfield and Kendall, 1994. 4.0 mm ♀, McCaulay Point, British Colombia. a, whole animal; b, telson; c, coxa 1; d, coxa 2; e, coxa 3; f, coxa 4; g, uropod 3; h, gnathopod 1; i, gnathopod 2; j, dorsal view of pereon; k, upper lip; l, right mandible; m, maxilla 1; n, pleopod 1; o, maxilla 2; p, maxilliped. Modified from Bousfield and Kendall, 1994.

Polycheria mixillae Bousfield and Kendall

Figure 47

Synonyms. Polycheria mixillae Bousfield and Kendall, 1994: 44, fig. 22.

Materials. Based on description in Bousfield and Kendall, 1994. Type species ♀, 4.0 mm, CMN-NNCC1994-0939, 9 ♀♀, Vancouver Island, Kirby Point, 25 June 1976, from sponge *Myxilla incrustans*, coll. R. Anderson (Bousfield and Kendall, 1994).

Type locality. Diana Island (Vancouver), British Columbia.

Description. Head appendages. Head, anteroventral margin rounded or obtuse. Eye, three fourths width of head; eye ovate. Antenna 1, subequal to antenna 2; peduncle segment 1 shorter than segment 2; flagellum with 10–20 articles. Antenna 2, peduncle articles 4 and 5 equal. Mandible, spine row 2–3; palp absent. Maxilla 1, outer plate with 7 spines. Maxilla 2, inner plate with 0–2 stiff setae; outer plate with 5 spines. Maxilliped, palp segment 4 present; exceeding outer plate; outer plate inner margin with 6–9 spines.

Thoracic appendages. Gnathopod 1, coxa squared anteriorly; coxa, anteroventral angle produced; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anterior margin with several long setae; carpus with long setae on posterior margin; carpus subequal to propodus; propodus twice as long as wide; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm exceeding length of dactyl. Gnathopod 2, basis with anteromarginal setae, with posterodistal setae, and with posteromarginal setae; propodus subequal to carpus; palm medium. Pereopods 3–7, prehensile or parachelate. Pereopods 3 and 4, carpus shorter than propodus. Pereopod 3, anteroventral process of coxa less than three times its basal width. Pereopods 5 and 7, carpus shorter than propodus; pereopod 7, basis sublinear; pereopod 7, dactyl less than half length of carpus. Epimeral plate 3, posteroventral margin squared.

Abdominal appendages. Urosomite 1, dorsal margin low, not produced posteriorly. Urosomites 2 and 3, with 0–3 dorsal spines. Uropod 1, peduncle with strong row of short spines on inner and outer dorsolateral margins and fringed with ventral setae. Uropod 3, both rami strongly spinose marginally; inner ramus longer than outer ramus; inner ramus greater than twice the length of peduncle and longer than uropod 1 and telson; outer ramus shorter than inner. Telson, broadest medially; half as broad as long; cleft less than 80%; attaining middle of uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Symbiotic with sponges.

Depth occurrence. Less than 1 meter.

Distribution. Vancouver Island, British Columbia

Cosmopolitan geographical area. Pacific Ocean. West coast of North America.

Remarks. Bousfield and Kendall (1994) state that *P. mixillae* is closely related to *P. carinata* within the North American taxonomic complex of *Polycheria* species, which includes *P. osborni* and the four news species described from the Western Atlantic in this report. *Polycheria mixillae* can be separated from *P. carinata* by the following characters: the short anteroventral process of coxa 3, the weakly setose peduncle and flagellum of antenna 2, and the basally slender dactyl of gnathopod 1. It is distinguishes from *P. osborni,* along with *P. carinata,* by the few number of marginal spines on the telson (5-6 compared to 7-8), it rather large eye, covering about 75% of the head, and the shorter dactyl of gnathopod 1, extending less than 50% of the length of the palm. Bousfield and Kendall (1994) reported that *Polycheria mixillae* is associated with the Demospongia *Mixilla incrustans* (sic). This makes it rather unique in that previous reports of hosts from the western coast of North American have been exclusively ascidians. *Myxilla incrustans* Bowerbank, 1866 is a parasitic sponge that occurs throughout British Columbia and Alaska and bores into the shells of scallops.

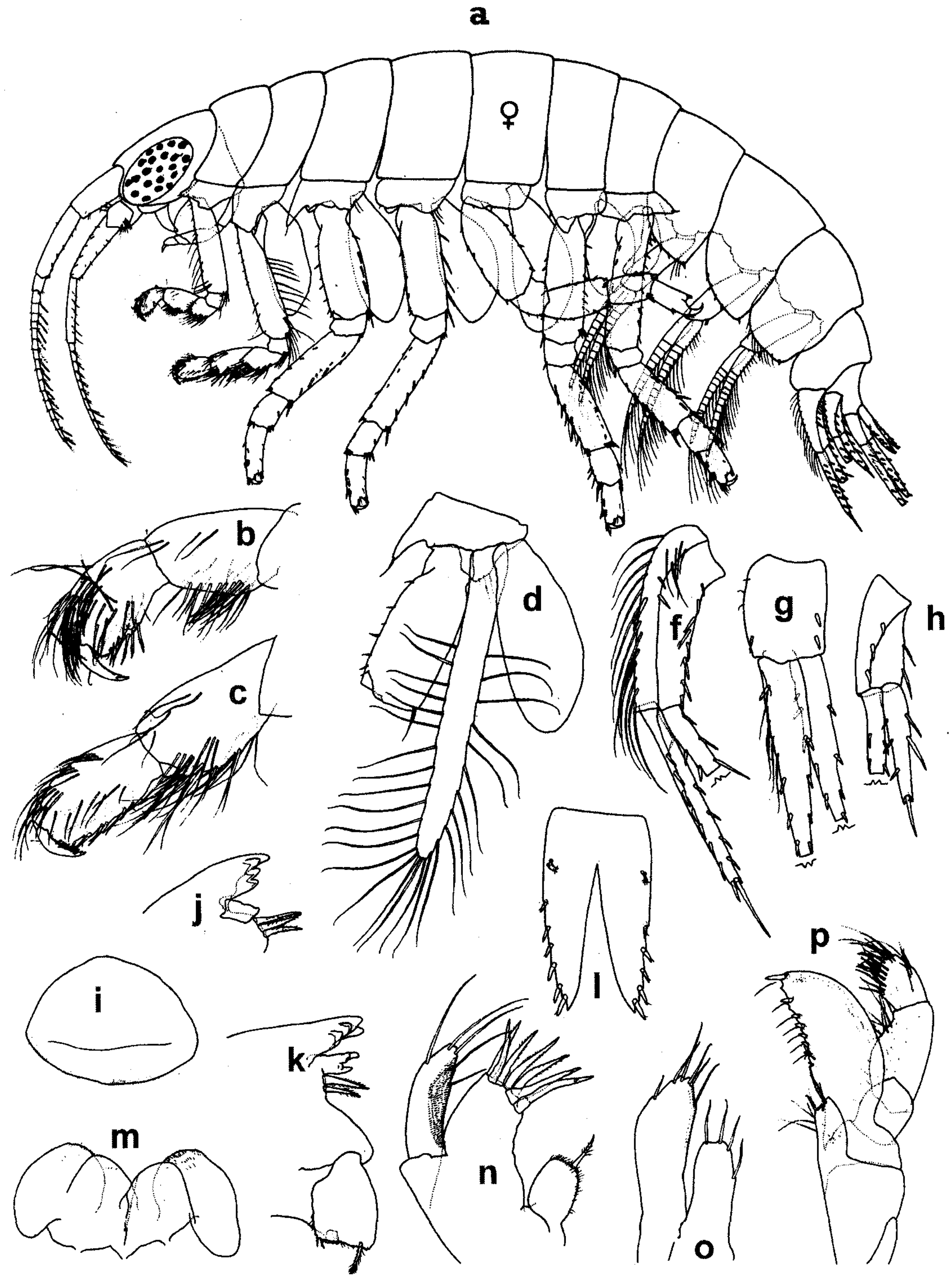

Figure 47 - *Polycheria mixillae* Bousfield and Kendall, 1994. Ovigerous ♀, 5.0 mm, Diana Island, Barkley Sound, British Columbia. Modified from Bousfield and Kendall, 1994. a, whole animal; b, gnathopod 1; c, gnathopod 2; d, pereopod 5; f, *uropod* 1; g, uropod 3; h, uropod 2; i, upper lip; j, left mandible; k, right mandible; l, telson; m, lower lip; n, maxilla 1; o, maxilla 2; p, maxilliped.

Polycheria osborni Calman

Figure 48-49

Synonyms. Polycheria osborni Calman, 1898: 268, pl. 32, fig.2; ; Skogsberg and Vansell, 1928: 269–285, fig. 1–26; Alderman, 1936: 63; Hewatt, 1937: 199; Barnard. 1954:21; Barnard, 1958: 39; Barnard, 1966:13; Barnard, 1969a: 103; Barnard, 1969b: 200, fig. 25g; Vader, 1969, 62, fig. 2c; Barnard, 1979: 9,13,38; Lambert, 1979: 467; Abbot and Newberry, 1980: XXX; Staude, 1987: 375, 382, 382, fig. 18.1; Barnard, 1991: 198; Barnard and Karaman, 1991: 220; Bousfield and Kendall, 1994: 37-41, figs.18–20. – *Polycheria antarctica.* – Stebbing, 1906: 521; Ricketts, Calvin, and Hedgpeth, 1968: 110–111, 492, fig. 78 .

Materials. 1 copulatory ♂ 2.5 mm, 1 ovigerous ♀ 2.8 mm; 6 ♂♂, 10 brooding ♀♀, 1 ovigerous ♂, 24 unsexed specimens; 1 non-copulatory ♂ 4.0 mm (dissected-illustrated), USNM, Top Dex 3, Gulf of California, 1.6 km seaward of Topolobampo (Sinaloa), Mexico, depth 1.0 meter, on sponges and ascidians on rocks, 25 November 1971, coll., J. L. Barnard, det., J.L. Barnard; 3 ♂♂, 1 ♀, host - *Amaroucium* ZMCC-CRU-4981, tide pool, Carmel, Monterrey Bay, California, July, 1927, coll., J. Skogsberg, det., J. Skogsberg.

Type locality. Puget Sound.

Description. Head appendages. Head, anteroventral margin rounded or obtuse; head large, equal to pereonites 1–2 combined. Eye, one half width of head; eye reverse reniform; eye brownish black in alcohol. Rostrum absent. Antenna 1, shorter than antenna 2; peduncle segment 1 shorter than segment 2; flagellum 21–25 articles. Antenna 2, about one-half body length; peduncle articles 4 and 5 equal; flagellum longer than peduncle. Mandible, spine row 2–3; molars triturative; teeth on lacina mobilis 3; palp absent. Maxilla 1, inner plate apex rounded; with 5 terminal setae; outer plate truncate terminally; outer plate with 7 spines; palp subequal to outer plate; palp sublinear, tapered distally; palp with 5–6 terminal and subterminal setae. Lower lip, outer lobe not projecting laterally. Upper lip, apical margin broadly rounded with fine lateral and facial setae. Maxilla 2, inner plate slightly shorter than outer plate; with 6–7 terminal and outer marginal stiff setae; outer plate with 7 stiff, plumed setae. Maxilliped, palp segment 4 present; shorter than outer plate; length equal to width of palp segment 3; outer plate inner margin with 10–12 spines; inner plate one-fourth length of outer plate; outer plate reaching distal margin of palp segment 4; inner plate with 5 or 6 stiff, plumed terminal setae.

Thoracic appendages. Gnathopod 1, coxa blunt, produced; coxa, anteroventral angle produced; basis sublinear, equal to ischium, merus, carpus, and propodus combined; basis anteromedial margin with 4–5 elongate setae and several shorter marginal setae; carpus with long setae on posterior margin; carpus longer than propodus; propodus narrowed at base; propodus shorter than carpus; propodus anterior and posterior margins with long simple and plumose setae and with heavy facial setae; males (notch) without deep notch on anterior margin; palm convex, finely pectinate; dactyl bifid distally and exceeding palm, broadly curved. Gnathopod 2, coxa anterior margin with small triangular tooth produced downward; basis longer than basis of gnathopod 1; merus greater than length of carpus; merus posterior margin with elongate setae; propodus shorter than carpus; propodus broad distally; palm length equal to dactyl; palm defined by two slender distal spines; dactyl shorter than palm. Pereopods 3–7, prehensile or parachelate; coxal gills weakly pleated. Pereopods 3 and 4, carpus shorter than propodus. Pereopods 5–7, coxae broad, wider than deep. Pereopod 3, anteroventral margin of coxa anteroventral margin produced into a strong, ventrally directed tooth; process of coxa less than three times its basal width; posteroventral margin of coxa acuminate or acute; basis posterior margin with sparse setae; merus equal to carpus and propodus combined; merus with 2 or 3 short posterior marginal setae and a long anterodistal spine; carpus slightly shorter than propodus; carpus posterodistal and anterodistal margins with short spines; propodus posterior margin produced, with 2–3 distal spines and with 3 anterior marginal spines. Pereopod 4, anteroventral angle of coxa produced to form blunt tooth; posteroventral angle of coxa rounded; merus longer than carpus and propodus combined. Pereopod 5, coxa, anteroventral and posteroventral angles rounded; basis longer than merus without posterior lobe at base; merus shorter than carpus and propodus combined; carpus longer than propodus. Pereopod 6, coxa with a triangular tooth anteriorly; basis with 4 posterior spines on distal half; merus with 3 short anterior marginal spines and 3 long stiff setae; carpus with anterodistal and posterodistal spines; propodus with 2–3 anteromarginal spines. Pereopod 7, coxa anteroventral angle rounded and posterior margins sharp; pereopods 5 and 7, carpus subequal to propodus; basis posterior margin with 3 strong, upturned spines on proximal half and 3 short spines distally and sublinear; merus shorter than basis; merus with anterior and posterior marginal setae; carpus with anterodistal and posterodistal spines and anterodistal spines half length of propodus; dactyl less than half length of carpus; propodus produced distally with 2–3 spines and palm with short, strong distomedial spine. Epimeral plate 1, posteroventrally acuminate and ventral margin with 2–3 short, curved spines; 2, posterodistally produced, rounded and ventral margin with 2–

3 short, curved spines; epimera 2 and 3, anteroventral margin with setae; 3, posteroventral margin rounded; 3, ventral margin with plumed setae and one strong spine at posteroventral angle.

Abdominal appendages. Urosomite 1, dorsal margin dorsal keel with acute posterior process. Urosomites 2–3, fused with a mid-dorsal saddle-shaped indentation; 2 and 3, with 0–3 dorsal spines; urosomite 2–3, dorsolateral margins rounded. Uropod 1, shorter than uropod 3; peduncle with ventral plumed setae and a row of dorsolateral spines; inner ramus shorter than outer ramus; peduncle equal to outer ramus, longer than inner ramus; rami outer ramus with dorsolateral spines and inner ramus with dorsolateral spines. Uropod 2, shorter than uropod 1; peduncle equal to outer ramus in length; inner ramus shorter than outer ramus; rami with long apical spines. Uropod 3, peduncle one fourth length of inner ramus; with 1–3 dorsolateral spines; rami lanceolate, distally upturned; inner ramus with 2–3 outer marginal spines and 1 inner marginal spine and outer margin of outer ramus with 1–3 short spines; inner ramus twice length of telson; inner ramus greater than twice the length of peduncle and longer than uropod 1 and telson; outer ramus three-fourths length of inner ramus. Telson, broadest medially; width two-thirds length; cleft about 80 percent to base; shorter than uropod 3; lateral setation present; with 4–6 lateral spines; apical spines present; apical spines equal to marginal spines.

Habitat. Rocky intertidal, among sponges and tunicates (*Amaroucium*).

Depth occurrence. Less than 1 m.

Distribution. Central California to British Columbia and SE Alaska, south to Gulf of California and Galapagos Islands.

Remarks: Calman (1898) described this species from the materials collected in a faunal survey of Puget Sound. It does not appear in the literature until Skogsberg and Vansell (1928) completed a detailed redescription of the species based on material collected at Monterey Bay, California. They completed the most detailed ecological and behavioral account of a species within the family Dexaminidae that has been accomplished to that date. *Polycheria osborni* is a widely distributed species, with records from as far south as the Galapagos Islands (Barnard, 1991) to southeastern Alaska (Bousfield and Kendall, 1994). Because of this wide geographical range, the probability is high that *P. osborni* is a complex of sibling species. Skogsberg and Vansell (1928) in their detailed redescription commented that *P. osborni* demonstrated a degree of plasticity in a particular locality, where physical-chemical conditions were relatively constant, that across its range considerable variability should be expected.

The *Polycheria osborni* material examined form the Gulf of California for this report, of which 77 characters were coded for the cladistic analysis (Chapter 5), is a more apomorphic species than the other two species that occur on the western coast of North America, *P. carinata* and *P. mixillae.* To assess the validity of the material from the southern part of the range of *P. osborni,* a detailed study of material throughout its range is needed. Barnard (1991) considered all the records of *P. osborni* as one species.

Polycheria osborni is readily separated from its East Pacific neighbors by its small eyes, generally covering on the anterior half of the head (with the exception of the copulatory male which possesses very large, reniform eyes), the strong anteroventral process on coxal plate 3, and the larger number of marginal spines on the telson. Bousfield and Kendall (1994) described the copulatory male; among the differences with the female are the reduced processes on the coxal plates, the additional setation of the antennae, and the dorsally produced keel on urosomite 1. Sub-adult males are separable from females only when the females are ovigerous or by examination for the presence of penes.

The most commonly reported host of *P. osborni* has been the compound ascidian *Amaroucium* (Skogsberg and Vansell, 1928; Alderman, 1936; Ricketts et al., 1968, Vader, 1969; Bousfield and Kendall, 1994), but it has been reported also from *Cystodytes* sp. (Lambert, 1979).

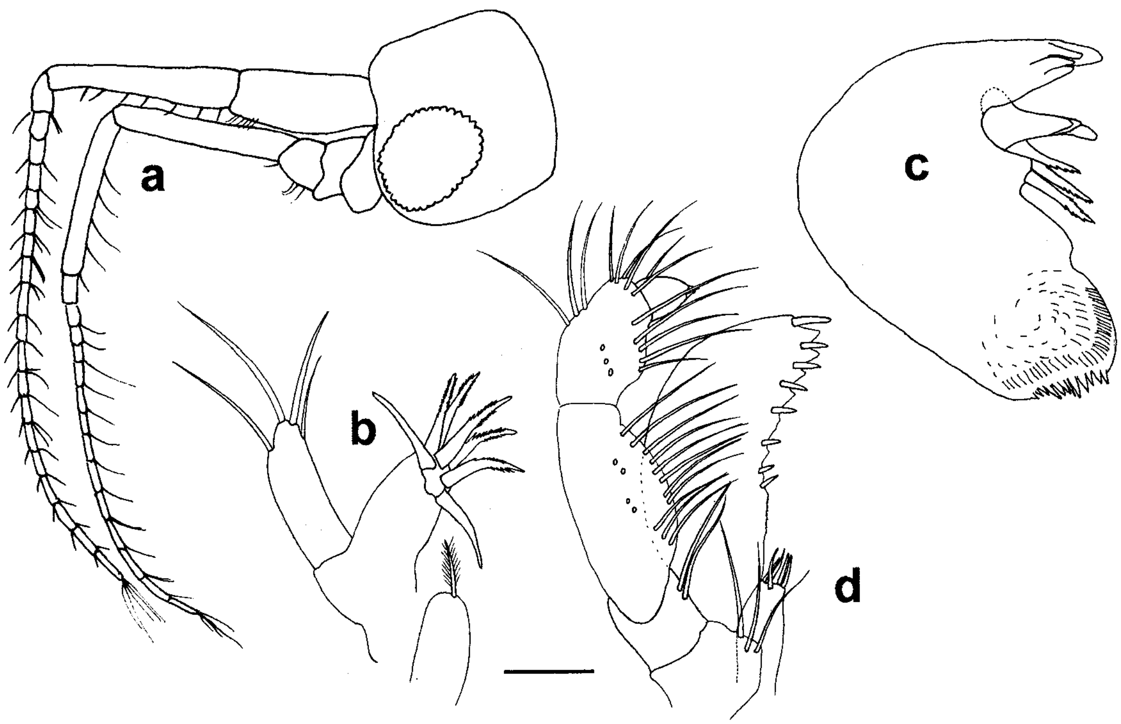

Figure 48 - *Polycheria osborni* Calman, 1898. ♂, 4.0 mm, USNM Top Dex 3, Topolobampo, Mexico (Gulf of California). a, head and antenna 1-2; b, maxilla 1; c, mandible; d, maxilliped. Scale = 0.10 mm – b, d.

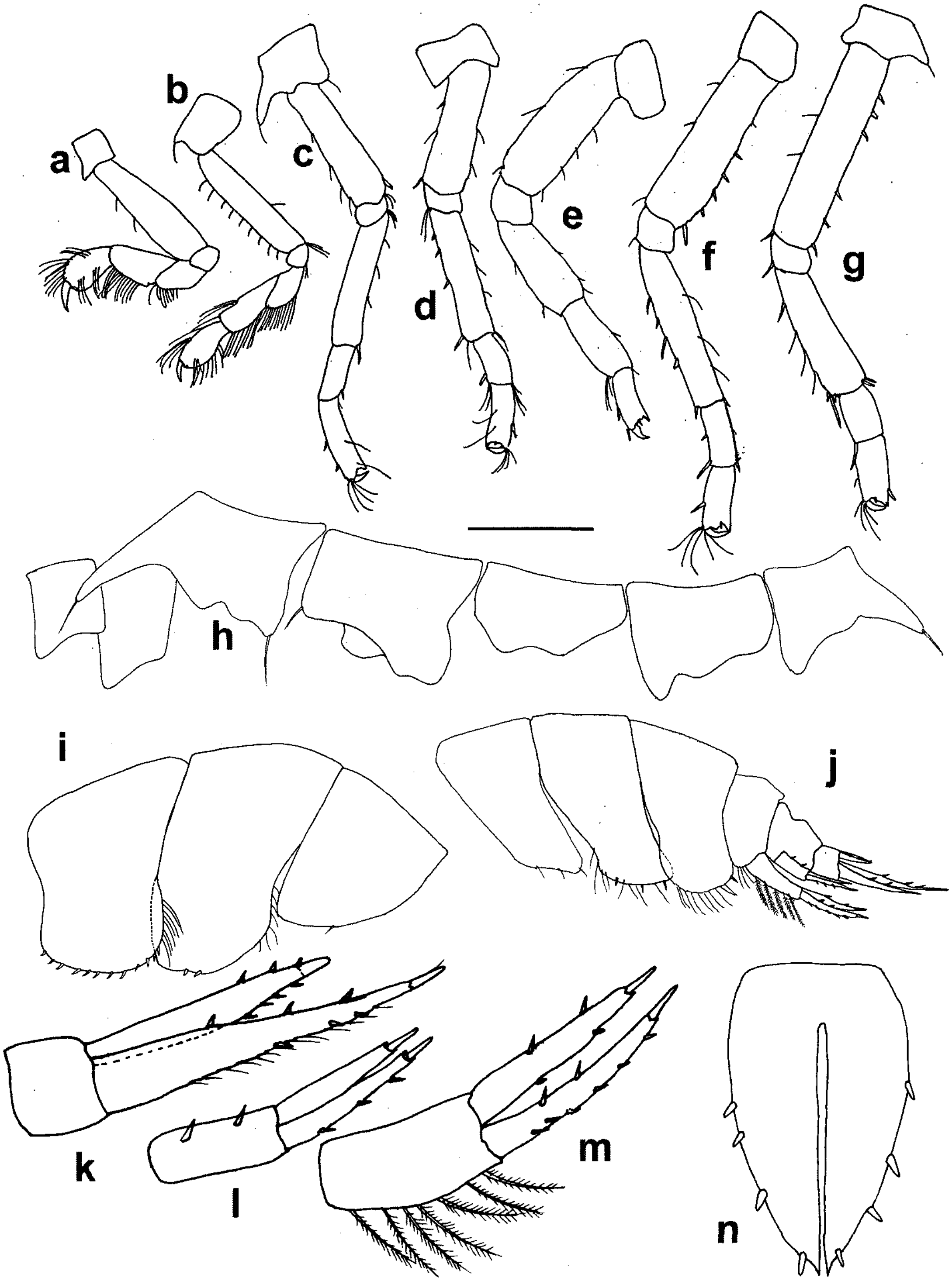

Figure 49 - *Polycheria osborni* Calman, 1898. ♂, 4.0 mm, USNM Top Dex 3, Topolobampo, Mexico (Gulf of California). a, gnathopod 1; b, gnathopod 2; c, pereopod 3; d, pereopod 4; e, pereopod 5; f, pereopod 6; g, pereopod 5; h, coxal plates 1-7 (left to right); i, epimeral plates 1-3, left side; j, pleosome and urosome; k, uropod 1; l, uropod 2; m, uropod 3; n, telson. Scale = 0.50 mm – h.

Key to the species and forms of *Polycheria* Haswell

1a Pereopod 4, coxa with posteroventral angle rounded (Group I)..........................2

1b Pereopod 4, coxa with posteroventral angle sharp or acuminate (Group II).......13

2a Head, anteroventral margin sharply produced forward............*P. acanthocephala*

2b Head, anteroventral margin produced bluntly or rounded..............................3

3a Pereopods 3-4 stout; merus longer than propodus..4

3b Pereopods 3-4 slender; merus subequal to propodus....................*P. gracilipes*

4a Pereopods 3-4 coxae with a strong tooth at the anteroventral margin................5

4b Pereopods 3-4 coxae anteroventral margin rounded..........................*P. similis*

5a Gnathopod 1, anteroventral margin of coxa not produced..........................13

5b Gnathopod 1, anteroventral margin of coxa produced................................6

6a Pereopod 5, carpus equal to propodus...7

6b Pereopod 5, carpus longer than propodus..8

7a Epimeral plate 3 with ventral spines..................................*Polycheria* sp. B

7b Epimeral plate 3, ventral margin with setae only ....*P. carinata*

8a Uropod 1, peduncle and rami with a strong row of dorsolateral spines..............

....*P. kergueleni*

8b Uropod 1, peduncle and rami without a strong row of dorsolateral spines.........9

9a Coxa 3, anteroventral process greater than three times the width at the

base...*Polycheria* sp. C

9b Coxa 3, anteroventral process less than three times the width at the

base...*Polycheria* sp. E

10a Pereopod 7, posteroventral angle of coxa produced and acute........................11

10b Pereopod 7, posteroventral angle of coxa not produced, rounded...................12

11a Uropod 3, rami subequal; coxa 4 produced rounded at posteroventral margin.......
....*P. mixillae*

11b Uropod 3, inner ramus longer than outer ramus; coxa 4 posteroventral margin
produced...*Polycheria* sp. D

12a Telson with 7-8 lateral spines; uropod 2 with dorsolateral spines......................
....*P. osborni*

12b Telson with 4-6 lateral spines; uropod 2 without dorsolateral spines.................
....*Polycheria* sp. A

13a Urosomite 3, dorsolateral teeth rounded...14

13b Urosomite 3, dorsolateral teeth acute..*P. dentata*

14a Uropod 3, inner ramus not longer than 2.5 times length of peduncle...............15

14b Uropod 3, inner ramus about 4 times length of peduncle...............*P. intermedia*

15a Urosomite 3 strongly produced posteriorly with many spines...............*P. cristata*

15b Urosomite 3 weakly produced with few spines........................*P. acanthopoda*

16a Pereopods 5-7 coxae broad, length less than twice width ....*P. antarctica*

16b Pereopods 5-7 coxae narrow, length more than twice width.........................17

17a Eyes very large in both sexes, diameter greater than half height of head............
....*P. macrophthalma*

17b Eyes not very large, diameter less than half height of head..........................10

18a Pereopod 4, coxa with anterior tooth..*P. bidens*

18b Pereopod 4, coxa rounded anteriorly..*P. tenuipes*

CHAPTER V

CLADISTIC ANALYSIS AND BIOGEOGRAPHY

Results

The topology selected for forming hypotheses about the relationship of the species and forms of *Polycheria* was the 50% majority rule consensus tree (Figure 50). It was selected from 440 equally parsimonious trees.

The outgroup *Dexamine spinosa* roots the tree. *Tritaeta chelata* and *Tritaeta gibbosa* are

found at the base of the tree with majority rule consensus values (MRCV) of 100% for and a decay index (DI) of 3. The remainder of the tree is comprised of the 27 representatives of the genus *Polycheria* included in the present study. This clade was well supported with a majority rule consensus value (MRCV) of 100% and a decay index of 2

Within the clade containing representatives of *Polycheria*, the species *P. obtusa* is found at the basal node of the clade while the remainder of the genus forms a monophyletic clade with MRCV of 95% and decay index of 1. Seven Indo-West Pacific species of *Polycheria* (containing *P. amakusaensis, Polycheria sp. E, P. tenuipes, P. brevicornis, P. orientalis, P. japonica,* and *P. atolli.*) are found to form a monophyletic clade with MRCV of 60% and a decay index of 1. The five smaller nodes that separate the seven species have majority rule values 52-75 and decays indices of one.

The next clade is comprised of a monophyletic clade containing *P. antarctica* with a MRCV of 60% and a DI of 1. The remaining taxa consist of 18 species found on both coasts of the Americas and in the waters surrounding Antarctica. The clade is supported by a MRCV of 60% and a DI of 1.

The next two monophyletic clades are rooted with *P. antarctica* f. *bidens* with a MRCV of 55% and DI of 1 and *P. antarctica* f. *dentata* with a MRCV of 70% and a DI of 1. The other side of the node supports a cluster of species including *P. antarctica* f. *nudus, P. antarctica* f. *macrophthalma, P. antarctica* f. *cristata,* and *P. antarctica* f. *acanthopoda* which has a MRCV of 70% and a decay index of 1. Within this clade, the *P. antarctica* f. *acanthopoda* - *P. antarctica* f. *cristata* – *P. antarctica* f. *macrophthalma* branch has a MRCV of 93% and a decay index of 1.

Polycheria antarctica f. *kergueleni* and *P. antarctica* f. *intermedia* form a clade with a MRCV of 73% and a decay index of 2. The next species pair is comprised of *P. carinata* – *P. mixillae*, two East Pacific species, with a MRCV of 98% and decay index of 2. The two are separated from the remaining species by a node with a MRCV of 70% and a decay index of two. The next clade consists of *P. osborni*, and five species from the western Atlantic but is supported by MRCV of 45% and a decay index of one. With the exception of a single species (*P.* f. *similis*) the five taxa in this clade are known from the Gulf of Mexico and Caribbean Sea.

Discussion

Hypotheses

The analysis reveals that *Polycheria* is a monophyletic group characterized by prehensile dactyls on pereopods 3-7, absent palp on mandibles, lower lip inner and outer lobes well developed and fleshy, a 1-articulate palp on maxilla 1, and a 4-articulate palp on the maxilliped.

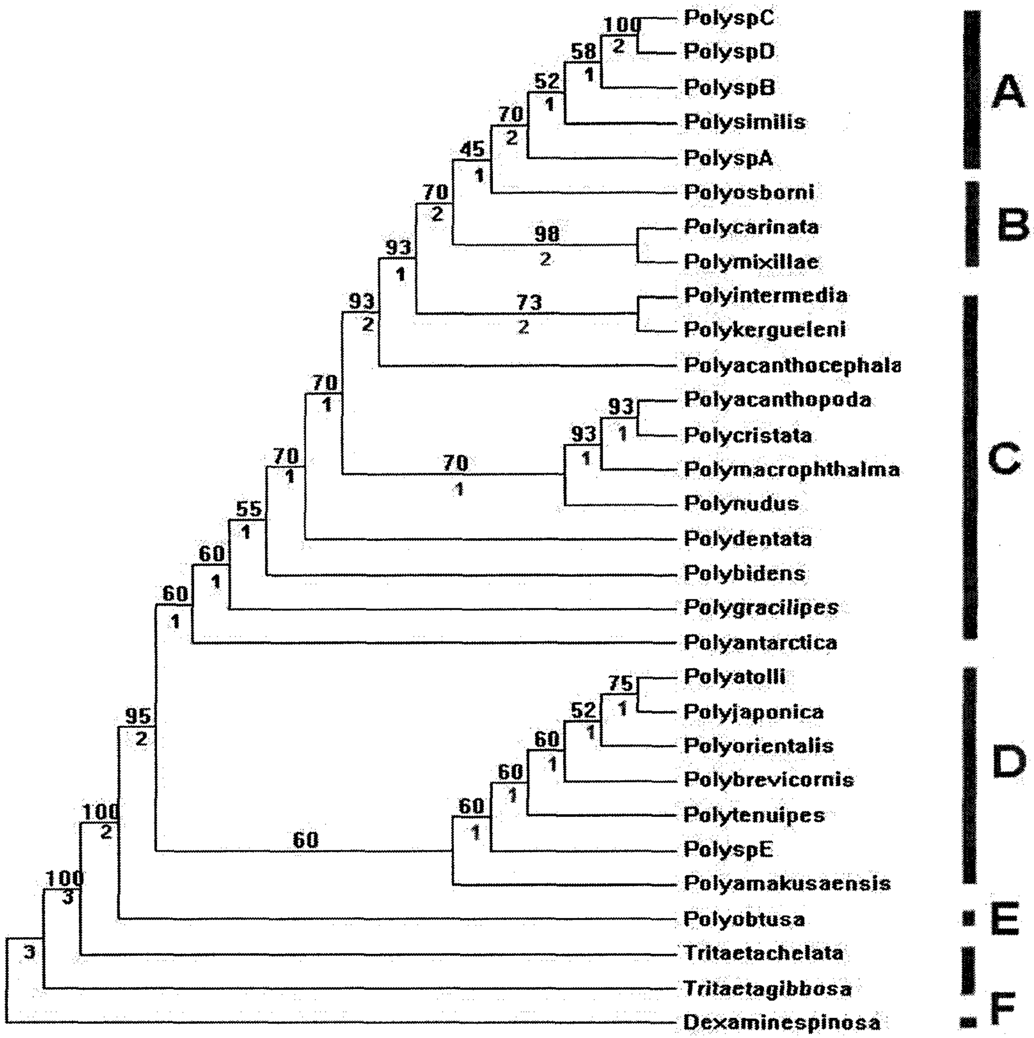

Figure 50 – *Polycheria.* Fifty percent majority rule consensus tree generated in PAUP from 77 parsimonious characters. Numbers on top of nodes indicate majority rule consensus values; numbers at bottom of the nodes indicate decay indices. Key – A , Western Atlantic species (with exception of *P. similis*); B, East Pacific species; C, Southern Ocean species and forms; D, Indo-West Pacific/Australia/New Zealand species; E, *Polycheria obtusa*, New Zealand; F, outgroups.

The hypotheses presented here, based upon the currently understood distribution of the species and forms of *Polycheria*, the current and historical position of the major world ocean currents and the continents, indicate that (1) *Polycheria* had it origins in the Southern Ocean, particularly in the region between Australia-New Zealand and Antarctica; (2) the dispersal of the ancestral *Polycheria* genotype occurred along at least two tracks – a circumpolar track eastward around Antarctica driven by the Antarctic Circumpolar Current, and along a northern track around New Zealand, along the coast of Australia and into the Australasian region and northward to the Sea of Japan; (3) the Antarctic Peninsula, which projects from the continent to within 1000 kilometers of South America and the shallow seas that surround it, was an area of high speciation from which dispersals eastward to the Indian Ocean and possibly Australia originated.

Biogeography/Phylogenetic Discussion

After the node separating *Tritaeta chelata* from the other outgroup taxa, *P. obtusa* lies separated from the two clades that contain the remaining species of *Polycheria.* The separation of *P. obtusa*, and the limit of its known range to New Zealand, suggests the possibility of an undescribed monotypic genus and possibly the closest ancestor to the basal group that formed the genus. The remaining species in that clade comprise the Indo-West Pacific group, a node supported by a MRCV of 95% and a decay index of 2. The basal species is *P. amakusaensis* and the most derived species is *P. atolli.*

The species of the Indo-West Pacific clade, which includes the type species *Polycheria tenuipes* and taxa extending as far north as the Russian maritimes, are clearly separate from the remaining species and forms of *Polycheria.* The analyses support the restriction of the use of the name *Polycheria* to the clade composed of the Indo-West

Pacific representatives. This would require all remaining taxa, currently assigned to the genus to one or more undescribed genera. The initial dispersal from the hypothesized center of origin would have involved the ancestors of this group. Because time frames are uncertain for the divergence of *Polycheria* from the Southern Ocean, it is not possible to say with accuracy where the Australian subcontinent laid in relation to Africa at the time when speciation and dispersal began. However, Australia and New Zealand were near their current location by 65 million years ago and the Tasman Sea had formed between them. Dispersal northward around New Zealand or through the Tasman Sea is probable. Also, tectonic activity on the eastern margin of the Australian continent was occurring at the time. Northward migration of smaller land masses (blocking) would have carried organisms toward the Australasian region, particularly *Polycheria* because of their sedentary life style associated with sponges and tunicates.

Another possible track of dispersal through the eastern Indian Ocean and into the Indonesian region may account for the species diversity in the Indo-West Pacific/Australian region. The Pacific Equatorial Current as it approaches New Guinea, Indonesia, and the Philippines in part splits into north and south into the eastern branches of the North Pacific (Kuroshio Current) and South Pacific gyres (South Australian Current). This could account for dispersal and radiation to Australia as well as East Asia. *Polycheria* sp. E is the most basal of the Indo-West Pacific/Australia species occurring in the West Pacific tropics.

The next five nodes in the tree include species that are associated with the Southern Ocean. Two possible exceptions are *P. f. acanthocephala* and *P. f. bidens* which are known from their type locality off the central Argentine coast. The lack of systematic studies in the Magellanic region and the tendency of many workers to refer to all occurrences of the genus as *Polycheria antarctica*, provides little resolution as to the actual range of these forms. Morphologically, they are distinct and they are widely separated in the tree topology, but have close geographic proximity in the few reports where they are mentioned (Schellenberg, 1931; Debroyer and Jazdzewski, 1993).

The largest cluster of Antarctic species is found around the Scotia shelf region, from the Antarctic Peninsula east to South Georgia Island. Four of the five Antarctic forms were described from that limited region: *P. f. acanthopoda, P. f. dentata, P. f. gracilipes,* and *P. f. nudus*. There is a possibility that this large number of species in such a relatively limited area, when compared to the total size of the marginal oceans and seas of Antarctica, reflects more intense field work in that part of the region. The Scotia shelf is a widely diverse region (Arntz and Gutt, 1999; Thurston, 1974a; 1974b) with respect to Amphipoda, but equally intense future research around the margins of the continent might produce reports of similar diversity. However, in the absence of that research, the hypothesis can be presented that Antarctica, and the Antarctica shelf in particular, is a region of rich speciation for *Polycheria,* as it is now defined.

Polycheria antarctica sensu lato was described from the Ross Sea, several hundred kilometers east of the Scotia shelf region. The history of the genus, the evolution of the name, and the subsequent lack of clarity in the literature are discussed in Chapter 2. Having been recorded throughout the Southern Ocean (and elsewhere), its status as a specific entity and its accurate range has not been well established. The extreme variability of the genus *Polycheria* and the lack of good keys and detailed descriptions made it difficult to separate it from the various forms. No doubt much material that could have been attributed to the other species and forms from the Southern Ocean have been attributed to *Polycheria antarctica*, especially prior to the description of the forms of Schellenberg (1931). Chilton (1912) suggested that all species of *Polycheria* (known as the time) were attributable to *P. antarctica*, at best a highly variable and widely distributed species.

The Kerguelen Islands, located in the Southern Indian Ocean about 2000 kilometers north of Antarctica, is the type locality of three forms of *Polycheria*. *Polycheria f. cristata* occurs in the tree at a point basal to the other two species found there, *P. f. kergueleni* and *P. f. intermedia*. While distribution information on many of these taxa, beyond their original description, is lacking, the position of *P. f. cristata* in the tree suggests an origin closer to Antarctica and subsequent dispersal to the Kerguelen Islands in the Southern Indian Ocean along the Antarctic Circumpolar Current. All three species are morphologically similar, but *P. f. cristata* has more pleisomorphic characters. It could be suggested that a speciation in isolation event occurred with *P. f. kergueleni* and *P. f. intermedia* diverging from an ancestral *P. f. cristata* or that they evolved separately, but later, in other parts of the ocean around Antarctica and made separate invasions of the Kerguelen Islands, in the manner suggested for *P. f. cristata*. The position of these three species on the tree suggests they may be derived from ancestral forms from the Antarctic Peninsula area that dispersed to the east.

The remaining members of the cladogram include mostly tropical to temperate ocean species. The exception is *P. f. similis* which was described from the Tierra del Fuego area (Schellenberg, 1931) and has been reported from the Strait of Magellan (Chiesa and Alonso, 2007). The original description is very short and Schellenberg only rendered one illustration - the first maxilla. The location of this species in the cladogram reflects the lack of data for this morphological form. No museum material was available, so the solution awaits the examination of more material; the material used by Schellenberg (1931) for description has not been located.

The species from the Southeast Atlantic Ocean, in the vicinity of the Plata region of Argentina, are spatially distant from their relatives in Antarctica. *Polycheria acanthocephala* and *P. bidens* possibly represent separate and recent dispersal and speciation into the South Atlantic Ocean from the Antarctic. The location of these species on different nodes of the cladogram suggests separate invasions rather than speciation after dispersal. Another species, *P. macrophthalma*, remarkable for its very large eyes in both sexes, was described from Ultima Esperanza, deep in the Strait of Magellan. The lack of transitional species from the coast of Chile suggests that no Pacific dispersal occurred across the Strait of Magellan and northward along the coast of South America. This species has not been reported outside its originally described range and no records of *Polycheria* exist from the west coast of South America except the occurrence of *P. osborni* from the Galapagos Islands (Barnard, 1991).

Polycheria atolli occurs widely in the Indian Ocean and its lineage is highly derived in comparison to *Polycheria* sp. E, so it is suggested that the ancestral lineage that gave rise to *P. orientalis* and *P. japonica,* morphologically similar species, gave rise to *P. atolli.* Having been described from the Maldives on India's west coast, *P. atolli* has a very wide range distribution suggesting a sibling species group. A detail study of variation across the range of this species has not been reported. The current range extends from Maldives westward into the Red Sea and Mediterranean Sea and southwest along East Africa to Madagascar and Southern Africa (Ruffo and Krapp, 2005; Ledoyer, 1982; K.H. Barnard, 1940; 1955).

The single exception to the hypothesis of an Indonesian origin of the East Pacific species is *P. amakusaensis*. Only reported from the Amakusa Sea of Japan, it is closely related to *P. orientalis,* also from Japan. The relationship between *P. japonica* and *P. orientalis* well supported by the tree (60% on the majority rule tree), but *P. amakusaensis* lies at the base of the Indo-West Pacific/Australia clade. Bousfield and Kendall (1994) reported the differences between *P. amakusaensis* and *P. orientalis* - among them the rounded posteroventral margin of epimeral plate 3 in *P. amakusaensis* and an acuminate margin in *P. orientalis.* This partially explains the more pleisomorphic condition of *P. amakusaensis* and suggests an initial dispersal and invasion of the Sea of Japan region by an ancestral *Polycheria,* the morphotype that became *P. amakusaensis,* and a subsequent invasion and speciation within the area resulting in at least two derived species (*P. japonica* and *P. orientalis*) derived from an ancestral *Polycheria* sp. E. There may be yet undiscovered species among the Japanese Islands and the Sea of Japan. Future work will possibly clarify the hypothesis and support the suggestion of this region as an active area of speciation.

Barnard (1976) reported *Polycheria antarctica* from Micronesia with the caveat that the genus was poorly understood and that under-sampled areas like the Indo-Pacific might be shown to have a great diversity of species. Research on a similar inquilinous genus, symbiotic with ascidians and sponges, *Leucothoe*, in the Indo-Pacific has resulted in an extreme diversity of host specific morphotypes (J.D. Thomas, pers. comm.). Similarly, recent examination of *Polycheria* specimens from Madang Lagoon, in Papua

New Guinea, suggests more undiscovered species, or at minimum, more intra-specific variation of *Polycheria* sp. E or with some common ancestor.

Aside from *P. antarctica* f. *similis*, all the remaining taxa occur along the coastal waters of North America. The North American Pacific species of *Polycheria* differ from the Asiatic species in several character states, mostly apomorphically. Both of these groups are different from the Southern Hemisphere species as exemplified by the *P. antarctica* complex of forms and related species (Holman and Watling, 1983; Bousfield and Kendall, 1994). The variation between the Asiatic and North American species suggest dispersal and speciation out of the Northwest Pacific, from the Sea of Japan region. *Polycheria mixillae* and *P. carinata* occur in the tree is a basal position to *P. osborni*, and in a table of pleisomorphic, intermediate, and apomorphic character states presented by Bousfield and Kendall (1994), *P. osborni* possesses clearly more derived characters states. The variation among these species suggests divergence from the ancestral species from the West Pacific into two (perhaps more) basal species which was ancestral to the large and highly variable *P. osborni* sibling species group. While these two slightly more pleisomorphic species have ranges limited to their type localities (both in British Columbia), *P. osborni* has been reported along the California coast southward to the Galapagos Islands (Barnard, 1954; 1969a; 1969b; 1975; 1979; 1991). A careful morphological and molecular genetics study of the representatives of this widely ranging species would most likely suggest increased variability southward through its range, perhaps even speciation.

The four new species from the Western Atlantic comprise the most derived cluster of taxa on the tree. *Polycheria* sp. A has the widest geographical range of the Western

Atlantic species, occurring from the northern Gulf of Mexico, southward along the peninsula of Florida and into Florida Bay. There appears to be a gap in distribution through the Florida Keys and northward to Amelia Island. At this point, there are a number of records from North Florida, Georgia, and South Carolina. No reports of *Polycheria* from the Mid-Atlantic and New England coasts of the United States have been located, but several species of the ascidian *Didemnum* spp., a known host of *Polycheria* sp. A, occurs in abundance in that area in such abundance as to qualify as a marine pest. *Polycheria* The historical biogeography of the Gulf of Mexico and Caribbean Sea, with regard to Amphipoda, has been summarized by McKinney (1977). sp. A is morphologically most similar to *P. osborni*. *Polycheria* sp. B, sp. C, and sp. D have respectively less similarity, but are more similar to each other and *Polycheria* sp. A than they are to *P. osborni*. This condition suggests two things (1) an ancestral species related to *P. osborni* moved eastward through the ancient Tethys Sea by way of the Panama Straits at some time prior to 3 million years ago; (2) gene flow was ended by the uplift of the Panamanian Isthmus and the ancestral Western Atlantic *Polycheria* speciated into at least four distinct morphotypes – the four new Western Atlantic species. Material from Panama has been examined and it appears transitional between *Polycheria* sp. B from the Yucatan Peninsula/Cozumel region and *Polycheria* sp. D from the southern Caribbean Sea (Curaçao). With the wide distribution and diversity of the ascidian and sponge fauna in the Caribbean Sea, the primary hosts for this symbiotic group, it would not be surprising that new collection efforts would discover new morphotypes. The historical biogeography of the Gulf of Mexico and Caribbean Sea, with regard to Amphipoda, has been summarized by McKinney (1977).

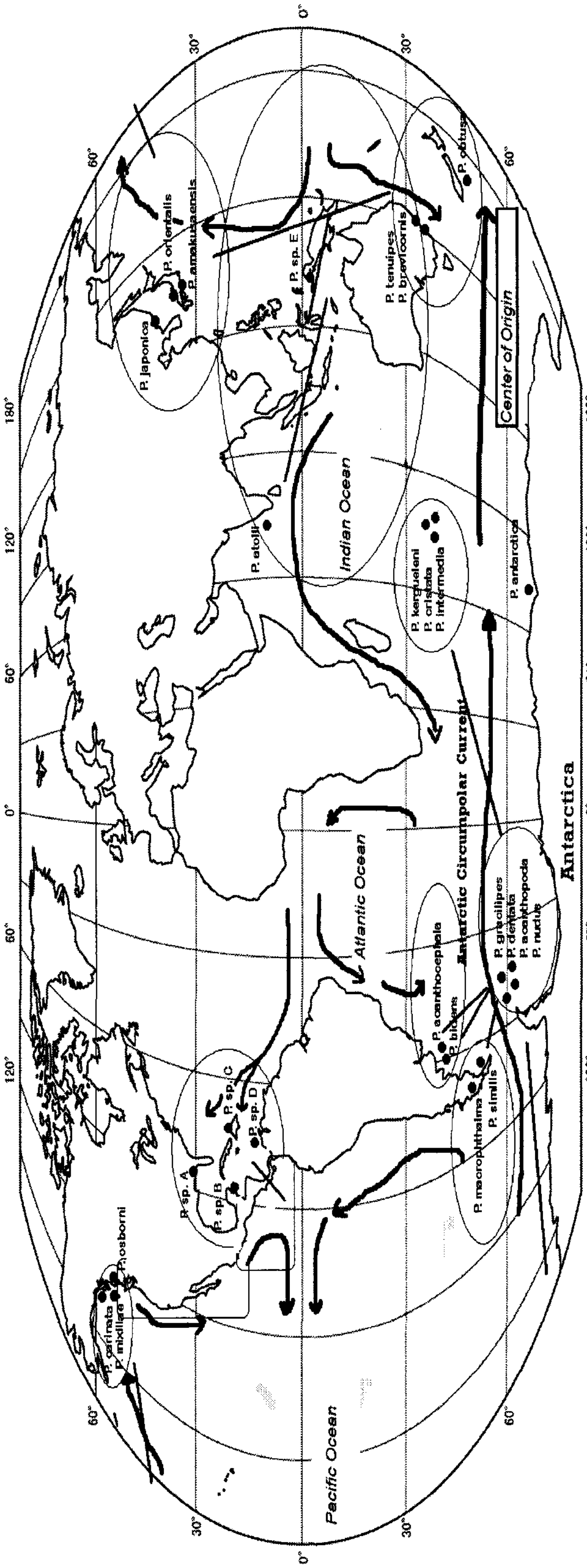
Pacific Ocean
Atlantic Ocean
Indian Ocean
Antarctica
Antarctic Circumpolar Current
Center of Origin
P. japonica
P. orientalis
P. amakusaensis
P. sp. E
P. tenuipes
P. brevicornis
P. obtusa
P. etolli
P. kerguleni
P. cristata
P. intermedia
P. antarctica
P. gracilipes
P. dentata
P. acanthopoda
P. nudus
P. acanthocephala
P. bifens
P. macrophthalma
P. similis
P. sp. A
P. sp. B
P. sp. C
P. sp. D
P. osborni
P. carinata
P. maxillare
0°
30°
60°
120°
180°

Figure 51 (p. 203) – Geographic clusters of *Polycheria* species with hypothetical evolutionary pathways. Key – Solid lines with arrow points represent ocean currents; straight lines indicate possible tracks of dispersal; ovals and rectangles represent species clusters based on current knowledge; dots represent the type localities of all known species and forms.

CHAPTER VI

SYMBIOSIS AND ECOLOGY OF *POLYCHERIA* IN ST. JOSEPH BAY, FLORIDA

Results and Discussion

During this study, the population of *Polycheria* sp. A occurring in St. Joseph Bay was found to be an obligate symbiont of several species of compound ascidians, including *Eudistoma* cf. *hepaticum* (Van Name, 1921), *E.* cf. *obscuratum* (Van Name, 1902), *Amaroucium* sp., and *Didemnum* cf. *candidum* Savigny, 1816. It occurred in excavations, shallow cavities or burrows, in the tough, semitransparent tunicin test of these tunicates; the species was not been observed in a variety sponges species examined in St. Joseph Bay area. The tunicates found associated with *Polycheria* sp. A were all collected from subtidal habitats, mostly in depths of less than 1.0 m; however, this subtidal occurrence is not universal for all records of the genus in ascidians or sponges. For example, on the rocky shores of California and Oregon, *Polycheria osborni* Calman, 1898 has been observed to occur intertidally, but only in sheltered situations where the amphipod is associated with algae or other sessile organisms and not exposed directly to open air (Skogsberg and Vansell, 1928). There is considerable variation in the depth occurrence reported species and forms of *Polycheria.* The depth reports, which were previously gathered Barnard by (1978), Bousfield and Kendall (1994), Skogsberg and Vansell (1928), Debroyer and Jazdzewski (1993), revealed that members of the genus occur over a wide range, from the intertidal zone to the deep sea in depths of 1200 m. The variations reflect the differences in the studies from which they were reported. Many of deep-water records came from ocean surveys in the Southern Ocean and Antarctica, while others came from reports dealing with near shore and coastal collections.

Collection methods varied from used of deep sea trawls to collections by hand in the intertidal zone.

Examination of *Polycheria* sp. A from more than 20 specimens of *Eudistoma* cf. *hepaticum*, a massive, burgundy colored tunicate, which reaches lengths greater than 200 mm, supported the observations by Skogsberg and Vansell (1928) regarding the habits of *P. osborni* Calman, 1898 in California. *Polycheria* sp. A, like *P. osborni*, occupies surface cavities on the exposed surfaces of the host rather than in dorsal folds of the tunic or on the undersides. The cavities are similar in shape and size of the amphipod. Another host in St. Joseph Bay was *Didemnum* cf. *candidum*, but rather than occurring as unattached, discrete colonies like *Eudistoma* spp., this tunicate was mostly found attached to the blades of the seagrass *Thalassia testudinum* Koenig, pen shells (*Atrina* spp.), or washed up on the bayshore entangled with algae and seagrass blades. Unlike the observations of *Polycheria osborni* from in Monterey Bay by Skogsberg and Vansell (1928), where that species more abundant on ascidians where most of the zooids were dead, *Polycheria* sp. A was observed only on ascidians that supported a dense growth of living zooids.

The excavations or domiciles inhabited by *Polycheria* sp. A on the surface of the host tunicate are not created by burrowing in a strict sense but by the use of the gnathopods and/or mouthparts. My observations of the *Polycheria* sp. A on *Eudistoma* sp. from St. Joseph Bay, indicate the amphipod settles on the surface of the tunicate, then positions itself with its dorsal surface against the surface of the tunicate, and then grasps the outer skin of the tunic with the dactyls of pereopods 3, 4, 6 and 7. Once in place on the surface of the tunicate, the animal pushes its dorsal surface against the surface of the tunicate host until its body breaks through the outer skin. Then, as described for *P. osborni* by Skogsberg and Vansell (1928), *Polycheria* sp. A inserts its body into the sub-dermal tissue (tunicin) of the ascidian until occupying a space that conceals its body and its appendages. When the amphipod has completed excavating its domicile within the sub-dermal tissue of the host and has folded its antennae against its body, the domicile opening is almost flush with the surface of the ascidian host. Once established within its host, *Polycheria* sp. A is positioned on its dorsum or back with the pereopods, antennae, and uropods facing upward, toward the opening of its domicile. The domicile or cavity is similar in size to the width and length of the amphipod epibiont that occupies it. Presumably, as the amphipod grows, it will lengthen and widen the burrow, but that activity was not observed in this study, nor has it been reported in the literature. The upside down orientation has been documented for several amphipod taxa. Barnard and Thomas (1986) observed a feeding behavior similar to *Polycheria* in the megaluropid species *Gibberosus myersi* (McKinney, 1980) in the Florida Keys. Like *Polycheria*, it is oriented on its dorsum or back (dorsal side down) and creates feeding currents with its pleopods; however, *G. myersi* burrows in sandy substrates and moves about within its habitat to gain feeding advantage. The species of *Polycheria* are completely sedentary. Skogsberg and Vansell (1928) did not observe *Polycheria* moving from its burrow until it was disturbed or when the conditions of the surrounding water changed drastically. In the present study, a *Eudistoma* colony was placed in a dish with seawater. The burrowed amphipods were physically disturbed using a small probe. After leaving their burrow, they made no effort to swim back to the tunicate, although they swam erratically around the tank. The disturbed individuals expired quickly and accumulated on the bottom of the dish, and as the water conditions in the dish deteriorated, others expired while remaining their burrows. A particular behavior of *Polycheria osborni*, not observed for *Polycheria* sp. A, was the tendency to shift ends of the burrow. Skogsberg and Vansell (1928) associated this behavior with the occurrence of four conditions in the test aquaria: (1) rise in water temperature; (2) strong mechanical stimulus (such as prodding); (3) oxygen deficiency; and (4) addition of harmful compounds. Observations of *Polycheria* sp. A, occupying burrows on *Eudistoma* cf. *hepaticum*, in a 4 L aerated test tank, revealed no shifting ends of the burrow with the creation of each of the four conditions listed above. The response, with the application of each condition, was the evacuation of the burrow, a short period of up-side-down swimming, and eventual settlement to the bottom of the tank.

Bousfield and Kendall (1994) pointed out that, unlike the apparently closely related ampeliscid amphipods, the known species of *Polycheria* do not possess spinning glands and thus are not capable of tube or domicile construction utilizing their own metabolic products (mucoproteins). Thus, in addition to an efficient platform for feeding, the domicile provides a mechanism to control the species of *Polycheria* from exposure to potential predators by having the ability of opening and closing the opening of the domicile. Observations made during my study dealing with how *Polycheria* sp. A controls the opening and sealing of its domicile, conform to those reported for *Polycheria osborni* from California waters by Skogsberg and Vansell (1928; 283) who state: "The edges of the burrow are held firmly by the distal fingers of the first, second, fourth, and fifth pereopods [i.e., pereopods 3, 4, 6 and 7 *sensu* Barnard and Karaman (1991)], and it is by the movements of these legs that the burrow is opened and closed." Alderman

(1936) reported observations of *Polycheria osborni* employing the third epimeral plates to close its cavity, in addition to the pereopods. This behavior offers a possible functionality of the short spines on the ventral margins of the epimera. *Polycheria* sp. A has rounded epimeral plates with slender ventral marginal setae, so this behavior may be a less likely option.

Observations on the domiciles of 30 randomly selected *Polycheria* sp. A, occurring on four colonies of *Eudistoma* and *Didemnum* from St. Joseph Bay, revealed that the cavities are longer than broad, with a width/length ratio of slightly less than half (.42) as wide as long. Skogsberg and Vansell (1928) reported slightly different results for *Polycheria osborni*, with the length of burrows 2.5 – 3.0 (.71) times the width, but gave no indication of the size of their sample or the actual dimensions of the burrows. The thirty burrows measured for *Polycheria* sp. A from St. Joseph Bay ranged in width from 0.5 – 1.5 mm and in length from 1.5 mm to 3.6 mm. The sample reflects the wide variation in size among the amphipods that make homes on a particular tunicate. The size range of the specimens of *P. osborni* examined did not vary significantly, except for the terminal males, from the specimens of *Polycheria* sp. A, but the width/length relationship of the burrows was significantly different (.46 compared to .71). Examination of 15 specimens of *Polycheria osborni* from British Columbia, Monterrey Bay, California, and Cabo San Lucas, Mexico did not reveal the broader pereonites that might be expected with the comparatively wider burrows than *Polycheria* sp. A. These size differences in domiciles are due to presence of one large, copulatory male and several juveniles among the amphipods removed from burrows on the sample tunicate.

In contrast to the behavior reported from California and St. Joseph Bay, Florida on ascidians, Dauby et al., 2001 documented the behavior of *Polycheria antarctica* on unidentified sponges in the Weddell Sea (Antartica) where it was observed to make hollows on the outer surfaces of the sponge. He reported *P. antarctica* to occur "with its head driven foremost into the sponge, few appendages projecting outside and creating a water current." (Dauby et al., 2001: 73). A comparison of the behavior of *Polycheria* sp. A with that of the Weddell Sea species was not possible because no specimens of *Polycheria* were recovered from sponges in St. Joseph Bay. Rutzler (1976) reported an unidentified species of *Polycheria* from the Gulf of Tunis occupying shallow cavities on the surface of three species of the demosponge *Ircinia.* This material has been examined and the preliminary identification is *Polycheria atolli* Walker, 1905. Several species of *Ircinia* occur in the study area in St. Joseph Bay, Florida (Little, 1963), but examination of *Ircinia fasciculata* (Pallas) de Laubenfels, 1948, *Halichondria melanodocia* de Laubenfels, 1936, *Cliona celata* Grant, 1826 and *Haliclona* sp. resulted in no specimens.

Tritaeta gibbosa (Bate, 1862), a dexaminid amphipod similar to *Polycheria*, was studied by Peattie and Hoare (1981) in the Menai Strait, on the western coast of Great Britain, to determine its density and behavior as an associate of the demosponge *Halichondria panacea* (Pallas, 1766). Fage (1932) reported this sponge species as a host of *Tritaeta gibbosa.* The similarity of the behavior of *Tritaeta gibbosa* to some members of the genus *Polycheria* is evidenced by the similar creation of cavities in the surface of the sponge in which the amphipod lies with its ventral side up. Peattie and Hoare (1981) observed *Tritaeta gibbosa* filter feeding from that position, much in the same fashion as *Polycheria.* As Skogsberg and Vansell (1928) observed for *Polycheria osborni, Tritaeta* *gibbosa* juveniles were found in more sheltered microhabitats of the sponge, suggesting the less disturbed areas of the host are preferred breeding areas. A few reports confirm that species of *Polycheria* occur in the plankton at night. A report for *Polycheria osborni* from vertical plankton tows off British Columbia, Canada (M. Galbraith, pers. comm.) has been located along with a report of *P. antarctica* occurring under sea ice in Antarctica among meroplanktonic and holoplanktonic crustaceans, as captured with light trap deposited beneath the ice (Kawaguchi et al., 1986). Peattie and Hoare (1981) indicated that the numbers of *Tritaeta gibbosa* in the plankton increased at night. Males were observed to migrate into the plankton during summer months, but examinations of the sponges themselves revealed that 70-90% of the *Tritaeta gibbosa* recovered from sponge samples in the study area were females, perhaps indicating that the occasionally planktonic males may be distributed by the movement of tides and currents. The nocturnal natatory behavior of the males may be a mating response to pheromones produced by seeking receptive females; example *Hargeria rapax* (R.W. Heard pers. obs.) or may be an evolved response to avoid predators. Due to the effects of tidal currents, the males perhaps settled in areas distant from the study area (Jones et al, 1973). *Tritaeta gibbosa* occurs in an area of the world ocean where *Polycheria* has been less frequently reported, Norway to Senegal on the West African coast and into the Mediterranean Sea and Black Sea. *Polycheria* overlaps the southern part of this range, especially *P. atolli* Walker, 1905. *Tritaeta chelata,* the only other species in the genus, has very similar morphology of *T. gibbosa* and presumably feeds in a like manner. Although reported in association with sponges (Fage, 1928), no publications of observations of its ecology has been located.

Except for a possible mating response as mentioned above, the known species of *Polycheria* are not a motile, but sedentary suspension feeders (Debroyer et al., 2001), and seldom leave their burrows. The members of this genus are capable of creating feeding currents with their pleopods and filtering particles from the water. The antennae are held against the body, therefore reflecting the functionality of the geniculate state of the antennal peduncle in feeding. Skogsberg and Vansell (1928) suggested that the bending of the antennae occurs when edible materials come in contact with the sensory setae. When the sensory setae on the antennae detect food particles in the water column, the flagella are raised to a perpendicular orientation to the body. The pleopods are nearly always in motion, although Skogsberg and Vansell (1928) observed them to stop for short intervals occasionally in aquarium studies, but they did not speculate on a reason. No resting period was observed in the feeding observations in the present study, but the observations occurred over a shorter period of time, 10 hours in an aerated culture dish compared to two days in an aquarium. Using the current created by the pleopods, food particles in the water are pushed across the setae of the antennae. When food is captured, the antennae are pulled down parallel to the body and the gnathopods and maxillipeds comb the setae of the antennal flagella for food particles and transfer them to the mandibles and maxillae before ingestion. Gut analyses show that *Polycheria osborni* feeds mainly on diatoms which it filters from the water current, but organic debris, microscopic organisms, and mineral particles have been reported (Skogsberg and Vansell, 1928; Ricketts et al., 1968; Bousfield and Kendall, 1994; Debroyer et al., 2001; Dauby et al., 2001). Gut examinations of *Polycheria* sp. A from St. Joseph Bay showed that diatoms of several distinct forms are the most identifiable items in the diet, but the gut contained a larger quantity of unrecognizable organic debris. Diatoms were among the large quantities of debris found on the setae of the mouthparts, a condition that may demonstrate of the efficiency of their filter or suspension feeding strategy.

I often observed dense clusters of adult and juvenile *Polycheria* sp. A on the test of the tunicate hosts in St. Joseph Bay. This clustering condition is explained by the tendency of juveniles to cling to the tunicate in close proximity to the mother until they can find abandoned burrows or make new burrows. My observations indicate that there is no post marsupial parental care for the small juveniles of *Polycheria* sp A., *e*specially not of type reported by Theil (2000), from Port Everglades, Florida, in which the adults *Leucothoe spinicarpa* harbored their young in the atrial cavity of the simple ascidians *Styela plicata* (Lesueur, 1823) and *Mogula occidentalis* Traustedt, 1883 for a critical period of maturation time.

Ovigerous females of *Polycheria* sp. A carried from 8-15 eggs. At release from the brood plates of the mother, young *Polycheria* are forced out of the burrow where they usually settle in a depression on the test near the mother that, but there are no observations of interactions between the juveniles and the mother after the release from the brood plates (Skogsberg and Vansell, 1928; J. Foster, pers. obs.). Because juveniles have limited ability to burrow, they can be washed away by currents before they can create a burrow or find shelter. Some occupy abandoned burrows on the tunicate surface as temporary shelter. Currents that wash the young off the tunicates provide a dispersal mechanism for the species (Skogsberg and Vansell, 1928; Ricketts et al., 1968; Barnard, 1975). In the present study, juveniles were observed on the surface of specimens of *Eudistoma* cf. *hepaticum* collected in St. Joseph Bay in July, 2004. Ovigerous females were observed in May, June, July, and September of 2004. The only cool season sample (December, 2005) produced numerous individuals of *Polycheria* sp. A on the tunicate *Eudistoma* cf. *hepaticum,* but no ovigerous females were collected. In July, 2007, in St. Joseph Bay cluster of *Polycheria* sp. A was observed on the tunicate *Eudistoma* cf. *hepaticum.* In this group there were three females, one ovigerous female, and one copulatory male. This clustering had not been previously, but if were to be observed as a pattern, it might suggest a harem-type mating behavior and would explain, somewhat, the efficiency of fertilization in a habitat where males and females are scattered in individual domiciles.

The density of *Polycheria* sp. A on the tunic of *Eudistoma* cf. *hepaticum* in July, 2004 was calculated at an average rate of two occupied slits per square centimeter of surface area, based upon the examination of six large (potato sized) specimens. No reports of *Polycheria* density in the literature have been located for ascidians, and only general references are available on their density in sponges (Debroyer et al., 2001). *Polycheria* has been frequently reported as a sponge commensal (Table 4). Arndt (1933) reviewed relationships between sponges and crustaceans and provided a chapter on amphipod-sponge relationships, providing the most detailed report to date on the variety of hosts selected by Crustacea in general, and *Polycheria* in particular.

Observations of the behavior of *Polycheria* from sponges in Antarctica differ from those on ascidians by Skogsberg and Vansell (1928) from California and mine from St. Joseph Bay, Florida. In a study of sponge dwelling Crustacea from the Weddell Sea, Kunzmann (1996) characterized *Polycheria antarctica* as an ectoparasite due to the presence of sponge spicules in the gut. Dauby et al. (2001) reported *Polycheria* *antarctica* as a commensal organism since only diatoms and organic debris were found in the gut contents of specimens collected in their study. Presumably, an ectoparasite on sponges would have spicule fragments in its gut; however, the presence of host tissue in the gut contents does not constitute the only reliable evidence of parasitism. The issue of defining commensalism and parasitism in crustaceans, particularly for members of the genus *Polycheria*, has been briefly addressed in the published literature; however, considering the differing views among the authors, no apparent consensus has been reached, leaving the matter open for further research.

APPENDIX A

Collection Stations – St. Joseph Bay, Florida (1990 – 2008)

Sta.	Location	Depth meter	Latitude	Longitude	Collection Dates	Personnel
1	1.48 km north of Blacks Island	1.0	29°44.40'N	85°19.57'W	21 Jul 2003	JMF/BPT
2	280 m west of Blacks Island	1.0	29°43.62'N	85°20.00'W	11 Jun 2004 22 May 2004	JMF/BPT
3	1.4 km NNW of Blacks Island	4.0	29°43.71'N	85°20.71'W	20 Mar 2004	JMF/BPT
4	340 m west of Blacks Island	1.0	29°43.51'N	85°20.08'W	22 May 2004	JMF/BPT
5	1.6 km west of Blacks Island	2.0	29°43.56'N	85°20.86'W	6 Jul 2004 4 Dec 2004	JMF/BPT
6	300 m NW of Blacks Island	1.0	29°43.65'N	85°20.00'W	11 Jun 2004	JMF/BPT
7	1.8 km west of Blacks Island	4.0	29°43.81'N	85°20.92'W	11 Jun 2004	JMF/BPT
8	0.5 km west of Blacks Island	2.0	29°43.52'N	85°20.20'W	6 Jul 2004	JMF/BPT
9	500 m SW of Blacks Island	1.0	29°43.23'N	85°20.37'W	6 Jul 2004	JMF/BPT
10	600 m SW of Blacks Island	1.5	29°43.21'N	85°20.40'W	6 July 2004 14 July 2004	JMF/BPT
11	250 m south of Blacks Island	2.5	29°43.22'N	85°19.86'W	6 July 2004	JMF/BPT
12	1.6 km north of Blacks Island	7.0	29°44.45'N	85°19.73'W	14 July 2004	JMF/BPT
13	500 m east of Blacks Island	1.0	29°43.51'N	85°19.51'W	14 July 2004	JMF/BPT
14	270 m NE of Blacks Island	1.0	29°43.73'N	85°19.82'W	14 July 2004 20 June 2006 22 July 2007	JMF/BPT/ RDF

					23 July 2007 24 July 2007	
AS-1	1.5 km west of Blacks Island	2.0	29°43.566' N	85°20.850' W	6 July 2004 4 Dec 2004	JMF/BPT
AS-2	900 m SW of Blacks Island	1.0	29°43.143' N	85°20.309' W	6 July 2004 4 Dec 2004	JMF/BPT
SJB-2	Palm Point Beach, St. Joseph Bay	0.0	29°51.236' N	85°20.400' W	15 Nov 1997 25 Nov 1997	JMF/BPT
SJB-6	Eagle Harbor, T.H. Stone State Park	1.0	29°45.918' N	85°24.021' W	5 May 1990	JMF/BPT

Note: All collections were made on a flooding or slack tide between 1000 and 1500 hrs local time. JMF – J. Foster; BPT – B. Thoma; RDF – R. Foster.

APPENDIX B

Synopsis of 77 characters as generated in DELTA (Dallwitz, 1980)

	char 1	char 2	char 3	char 4	char 5	char 6	char 7	char 8	char 9
P. acanthocephala	5	2	4		2				2
P. amakusaensis	5	1	4	1	5	2	3	2	2
P. antarctica	5	1	4		1&5	2			2
P. atolli	5	5				4	5		2
P. bidens	5	2	3	1	5	1	2		2
P. brevicornis		2							2
P. carinata	5	5	4		7	3	4		2
P. cristata	5	2	4	1	5	2	2	3	2
P. dentata	5	2							2
P. species B	4	4	4	1	7	1	3	1	2
P. species A	5	1	4	1	3	1	3	1	2
P. gracilipes	2	1	3	1	5	3	2	3	2
P. intermedia			2&4		4				2
P. kergueleni	5	1	4	1	5	3	5	2	2
P. japonica					5	4			2
P. mixillae	5	5			7				2
P. macrophthalma	5	2	4	1	5	4	2	3	2
P. nudus							2	3	2
P. obtusa	1	1							2
P. orientalis	5	5	1	1	5	3	5	2	2
P. osborni	5	3	4	1	7	1	2	2	2
P. similis					7	1			2
P. tenuipes	5	1		1	2	3	1	3	2
T. gibbosa	5	1							1
T. chelata			4	1	5	2	3		1
P. species C									2
P. species D									2
P. species E	5	1	4	1	1	3	1	3	2
Dexamine spinosa		4							

	char 10	char 11	char 12	char 13	char 14	char 15	char 16	char 17
P. acanthocephala	3	6	5	1	7	3		2
P. amakusaensis	1	8	5	1	7	3	7	2
P. antarctica	3	3	8	1		3	2	2
P. atolli		8		1	8	2	6	1
P. bidens				1	8	3	3&6	2
P. brevicornis				1			6	1
P. carinata	2	2	8	1	8	3	5	2
P. cristata	3	1	7	1	6	3	3	2
P. dentata		1		1	7	3	5	2
P. species B	1	4&5	4	1	2&3	3	3	2
P. species A	1	6	6	1	3	3	5	2
P. gracilipes	3	1	8	1	6	3	1&5	2
P. intermedia				1	6	3	3	2
P. kergueleni	2	7	3	1	8	3	5	2
P. japonica	3			1		2	4	1
P. mixillae	3	1		1	8	2	1	2
P. macrophthalma	3	1&8	3	1	8		3	
P. nudus		1		1	8	3	1	2
P. obtusa				1	1&6	3	3&6	2
P. orientalis	1	1&8		1	4	2	1&6	1
P. osborni	2	2	3	1	8	3	5	2
P. similis				1	3			
P. tenuipes	3	1	1&2	1	1	3	3&6	
T. gibbosa				1		1	3&6	3
T. chelata				1	1	3	7	2
P. species C				1	1	3		
P. species D				1	2&5			
P. species E	3	9	1&7	1	8	3	7	1
Dexamine spinosa				2	1			3

	char 26	char 27	char 28	char 29	char 30	char 31	char 32	char 33
P. acanthocephala	1	6	8	2	5	3	3&5	4
P. amakusaensis	1	5	5	3	1	4		
P. antarctica	1	6						
P. atolli	1	6	8		5	2		
P. bidens	1	4	7					
P. brevicornis	1							
P. carinata	1	5						
P. cristata	1	6	7		5	1	2	
P. dentata	1	4	8	2	3	4	1&2&3	3&4
P. species B	1	4	8	3	3	3	4&5&6	
P. species A	1	4	7	2	2	3	4&5&6	
P. gracilipes	1	4	4	2	4	3	2&3&6	4
P. intermedia	1	5	8		1	3		
P. kergueleni	1	6	7		2	3	3&5	4
P. japonica	1	3	5					
P. mixillae	1		7					
P. macrophthalma	1	4			5	2	3&5	3&4
P. nudus	1	4		2	5			
P. obtusa	1	6	5&7	2	1	3	1&3&4&6	
P. orientalis	1	2	5					
P. osborni	1	4	7	3	1	3	4&5	
P. similis	1				5			
P. tenuipes	1	6	4	2	2	4	2&3&5	3&4
T. gibbosa		5	3	2	1	2	2	1
T. chelata								
P. species C	1	6	8	1				
P. species D	1	4	5	1				3
P. species E	1	6	2&5	3	5	4	4&5	2&3
Dexamine spinosa	2	1	1					

	char 34	char 35	char 36	char 37	char 38	char 39	char 40	char 41
P. acanthocephala	4	1	4		5			
P. amakusaensis		4	3	3	5	6	3	
P. antarctica								
P. atolli		3	3		5	5	4	
P. bidens	5	4	1		5			
P. brevicornis								
P. carinata		2						
P. cristata		3	4	5	4	7	4	3
P. dentata		1	4	2	4&7	5	4	2
P. species B	6	4	4	2		7	2&4	3
P. species A	5	4	4	5	5	8	4	2
P. gracilipes		3	4	4	3&7	7	4	2
P. intermedia		1	4		5	7	4	
P. kergueleni	5		4	3	3&7	6&8	5	1
P. japonica		2	3		5	6		
P. mixillae								
P. macrophthalma		2	3	3	6	6	4	
P. nudus				5				
P. obtusa	5			3&4&5	5&7	3	1	3
P. orientalis								
P. osborni		4	4	2	5	7	4	2
P. similis		4	4					
P. tenuipes	3			5	2&3	3&8	3	2
T. gibbosa		3	3	2	3&6	3	3	1
T. chelata								
P. species C		4	1		6			
P. species D	5	4	1		2&5			
P. species E	5			1	5	2&4	5	2
Dexamine spinosa	1				1	1	4	

	char 42	char 43	char 44	char 45	char 46	char 47	char 48	char 49
P. acanthocephala	4		4&5		10	5		1
P. amakusaensis	3	6	5	1	8	4		1
P. antarctica			6					1
P. atolli	6		4			5	5	1
P. bidens	3		3					1
P. brevicornis								1
P. carinata				2				1
P. cristata	4	4	5		7&10	4	4&5	1
P. dentata	3&6	4	3&4		5&10	4	2&4&5	1
P. species B	2&7		3	3	6&12	4	3&4	1
P. species A	6	7&8	4&5	1	7&10	4	3	1
P. gracilipes	3&6	3	1&2		4&8	4	2&4&5	1
P. intermedia	5	8	6	3	10			1
P. kergueleni	5	8	6		3&8&9	4	2&4&5	1
P. japonica	6							1
P. mixillae				2	12			1
P. macrophthalma	2&3&7	2&4&9	1&2		7&10	4	2&4&5	1
P. nudus			5					1
P. obtusa	3&5	3&4	6		2&5&8	3	3&4&5	1
P. orientalis								1
P. osborni	3	5	4&7	3	6&12	4	3&5	1
P. similis								1
P. tenuipes	6&7	3&4	4&5&6		3&5&7	2&5	2&4&5	
T. gibbosa	1&4	7	4&5	3	8	3	4	1
T. chelata								1
P. species C	6		2&3			4	1&2	1
P. species D	1-Apr		2&3					1
P. species E	2&4	1	6	1	1&5&10	4	3&4&5	1
Dexamine spinosa						1		2

	char 50	char 51	char 52	char 53	char 54	char 55	char 56
P. acanthocephala		10		6	3	6	5
P. amakusaensis	8	10		6	8	4	
P. antarctica		5		5		11	5
P. atolli	7&9	7&11	4	4		4	
P. bidens	7&9	5		5	5&9	4	4
P. brevicornis				5		3&9	
P. carinata		9		7		11	
P. cristata	6	6		2	6	3&9	
P. dentata	7&9	5&11	4	4	5	3&4	3
P. species B	7&9	7&11		2	7	11	5
P. species A	7&9		5	7	9	4	6
P. gracilipes	5	5&11	3	5	5	2&8	3
P. intermedia	8	9		7		7	
P. kergueleni	3&6&8	4&9	5	5	4	2&8	
P. japonica		5&11		5		1	
P. mixillae				7		11	6
P. macrophthalma	4&5	10		6	8	2&4	2
P. nudus				4		5	
P. obtusa	2&5	2&3	4	1	2	9	1
P. orientalis	7&9	5&11		5		4	
P. osborni	7&9	7&11	5	8	7	4	6
P. similis							
P. tenuipes	2&5	2&3	4	1	2	2&4	2
T. gibbosa	5	2	1	4&5	5	10	1
T. chelata						9	
P. species C							
P. species D				2	9	2&12	6
P. species E	5	2	2	1	1	2&3&9	3
Dexamine spinosa	1	8		4		2&10	

	char 57	char 58	char 59	char 60	char 61	char 62	char 63	char 64
P. acanthocephala	3	2	8&11	2	2	1&2&3	7	6
P. amakusaensis		2	12	3	2	2&3	5	1
P. antarctica				2				
P. atolli	2		9			2&3		4
P. bidens		2	4&10	2	2	2&3	4&7	4
P. brevicornis								
P. carinata			11	3			8	
P. cristata	6	2	10	1		3		3
P. dentata		2	10	2	2	1&2&3	3	1
P. species B		2	7	2	2	4&5&8	7	
P. species A	4	2	11	3	2	7	8	5
P. gracilipes	3	2	3&12		5	8	5	6
P. intermedia		1	10					
P. kergueleni	5	2	4&11	2	2	2&3	5	6
P. japonica								
P. mixillae			8&11					
P. macrophthalma	5	2	4&10	3	2	1&2&3	6	1&3
P. nudus	3				2&3		7	
P. obtusa	4	2	2&12	3	1	1&2&3	1&6	3
P. orientalis		2	9	3	4		6	
P. osborni	6	2	6	2	5	2&3	6	5
P. similis								
P. tenuipes	4	1	2&7	3	3	2&4	2&6	5
T. gibbosa	4	2	8	3	2	7	5	2
T. chelata								
P. species C								
P. species D	3	2	11	3	2	1	4	3
P. species E	4	3	1&12	3	4	1&2&3	3	1
Dexamine spinosa		1						

	char 65	char 66	char 67	char 68	char 69	char 70	char 71	char 72
P. acanthocephala	1	7	5	5	2	9&10	6	5
P. amakusaensis	2	5	2		2	9&12	4	6
P. antarctica								
P. atolli	2	4	4		3	13	7	4
P. bidens	2	2	2	5		7&12	7	3
P. brevicornis								
P. carinata		6				12	7	5&6
P. cristata	2	2	3	2	2	11	6	6
P. dentata	1	2	5	5		5	2&4	6
P. species B		2		4	1	6&7	7	4&5
P. species A	1	2	2	3	2	10	7	6
P. gracilipes	2	2	2	3	2	4&5	2&5	5
P. intermedia			3			12	7	4
P. kergueleni	1	2	5	4	2	2&3	7	4
P. japonica						11	5	3&4
P. mixillae						10	7	5&6
P. macrophthalma		2&5	5	3	2	10	5	6
P. nudus						1&12	5	4
P. obtusa	2	2	1	1	3	12	1&7	6
P. orientalis	1	4&5				11	7	3&6
P. osborni		2	3	1	1	6&12	3	5&6
P. similis								
P. tenuipes	2	5	2	5	2	4&5	7	
T. gibbosa	1	2	2	3	3	10	6	6
T. chelata						11	4	
P. species C					2	12	7	
P. species D		2	3	1	2	5	7	4
P. species E	2	1&4&5	2	3	2	3	2&6&7	
Dexamine spinosa					3		4	1

	char 73	char 74	char 75	char 76	char 77
P. acanthocephala	5	3	2	6	2
P. amakusaensis		3	2	8	2
P. antarctica	5			2	2
P. atolli	5	1	4	5	1
P. bidens	2	4	2	6	2
P. brevicornis					
P. carinata	4	4	4	8	1
P. cristata	2	3	4	6	2
P. dentata	6	4	4	3	2
P. species B	4	1	4	7	1
P. species A	1	2	2	8	2
P. gracilipes	6	4	3	8	2
P. intermedia	2		4	8	2
P. kergueleni	2	3	4	8	2
P. japonica	2	4		6	
P. mixillae	2	3	4	8	2
P. macrophthalma	6	1	4	6	2
P. nudus	2	4	1	3	2
P. obtusa	4	1&2&3	1	8	2
P. orientalis	2	4	3	6	2
P. osborni	4	3	2	8	2
P. similis					
P. tenuipes		3	3	6	1
T. gibbosa	1	3	2	8	2
T. chelata	1	1	3	3	2
P. species C				1	1
P. species D				6	2
P. species E	2	1&4	1	6	1
Dexamine spinosa				6	

APPENDIX C

DELTA Editor set of 77 characters used for parsimony analysis

#1. Head, anteroventral margin <shape>/
  1. produced into a rounded lobe/
  2. forming a right angle the anterior margin/
  3. produced into a large straight tooth/
  4. produced into a small tooth/
  5. rounded or obtuse/

#2. Eye <shape>/
  1. rounded oval/
  2. round/
  3. reverse reniform/
  4. reniform/
  5. ovate/

#2. Maxilla 1, inner plate <shape>/
  1. triangular and roundish/
  2. broad/
  3. apex acuminate/
  4. apex rounded/

#3. Maxilla 1, outer plate <shape>/
  1. truncate terminally/

#4. Maxilla 1, outer plate with <number of spines>/
  1. 10 spines/
  2. 11 spines/
  3. 6 spines/
  4. 8 spines/
  5. 9 spines/
  6. greater than 11 spines/
  7. 7 spines/

#5. Maxilla 1, palp <length>/
  1. subequal to outer plate/
  2. long, not exceeding spine tips on outer plate/
  3. longer than outer plate/
  4. long, exceeding spine row of outer plate/

#6. Maxilla 1, palp <shape>/
  1. expanded distally/
  2. sublinear, tapered distally/
  3. sublinear, not tapering distally/
  4. bluntly acuminate distally/
  5. truncate distally/

#7. Maxilla 2, inner plate <length>/
  1. half length of outer plate/
  2. slightly shorter than outer plate/
  3. subequal to outer plate/

#8. Maxilliped, palp segment 4 <presence>/
1. absent/
2. present/

#9. Maxilliped, palp <length of palp>/
1. subequal to outer plate/
2. shorter than outer plate/
3. exceeding outer plate/

#10. Maxilliped, outer plate <spines>/
1. inner margin with 6–9 spines/
2. inner margin with 10–12 spines/
3. inner margin fringed with about 20 small spine teeth/
4. with strong terminal spine/
5. with 12 short disto-medial spines/
6. inner margin with 15 spines/
7. inner margin with 19–20 spines/
8. with spines and setae on distal third/
9. inner marginal spines with 1–5 spines/

#11. Maxilliped, inner plate <spines>/
1. with short, fine terminal setae/
2. with 2 short distal spines/
3. with 5 or 6 stiff, plumed terminal setae/
4. with 2 terminal setae/
5. with 7–8 spines on distal half of inner margin, several terminals spines/
6. with 4 simple terminal setae/
7. with 1–2 spines/
8. with plumed terminal setae/
9. with 5 marginal spines/

#12. Coxa plates 1–4 <length>/
1. length less than twice their depth/
2. length greater than twice their depth/

#13. Gnathopod 1, coxa, <shape>/
1. distally rounded, deeper than wide/
2. posteroventral margin produced and bluntly rounded/
3. anteroventral margin produced into strong tooth/
4. very small, subovate with 2 anterodistal setae/
5. anteroventral margin bluntly produced/
6. not produced anteroventrally, distally rounded/
7. distally rounded, wider than deep/
8. anteroventral angle produced/

#14. Gnathopod 1, carpus <size and shape>/
1. shorter than propodus/
2. subequal to propodus/
3. longer than propodus/

#15. Gnathopod 1, propodus <shape>/
1. twice as long as wide/
2. slender/

3. short and deep, width 60% of length/
4. short and deep, width 70% of length/
5. narrowed at base/
6. ovate/
7. subovate/

#16. Gnathopod 1, propodus <length>/
1. subequal to carpus/
2. shorter than carpus/
3. longer than carpus/

#17. Gnathopod 1, males (notch)/
1. without deep notch on anterior margin/
2. with deep notch on anterior margin/

#18. Gnathopod 2, coxa <shape>/
1. with a small acute process that the anteroventral margin/
2. subrectangular, with distal angles acute/
3. subrectangular with distal angles rounded/
4. anterior margin with small triangular tooth produced downward/
5. ventral margin sinuous/
6. anteroventral margin not produced forward, distally rounded/
7. posteroventral margin rounded/
8. distally rounded/

#19. Gnathopod 2, merus <relative length>/
1. half length of carpus/
2. subequal to carpus/
3. greater than length of carpus/
4. less than half length of carpus/
5. as long as carpus and propodus combined/

#20. Gnathopod 2, propodus <length relative to carpus>/
1. subequal to carpus/
2. shorter than carpus/
3. longer than carpus/

#21. Gnathopod 2, propodus <shape; ratio>/
1. with anterior notch in males/
2. narrowed proximally, subequal to carpus/
3. broad distally/
4. more slender than carpus/
5. 2 to 2.5 times longer than wide/
6. half as wide as long/
7. oblong, three times as long as broad/

#22. Pereopods 3–7, carpus <length relative to propodus>/
1. subequal to propodus/
2. shorter than propodus/
3. longer than propodus/

#23. Pereopods 3–7, <form of chelae>/
1. carpochelate/
2. prehensile or parachelate/

#24. Pereopods 3 and 4, carpus <length relative to propodus>/
    1. equal to propodus/
    2. longer than propodus/
    3. shorter than propodus/
#25. Pereopods 5–7, coxae <size>/
    1. broad, length more than twice width/
    2. each with a short process at the mid-ventral margin/
    3. broad, wider than deep/
#26. Pereopod 5–7 merus <length>/
    1. subequal or longer than carpus and propodus combined/
    2. shorter than carpus and propodus combined/
#27. Pereopod 3, anteroventral margin of coxa <shape>/
    1. subrectangular, rounded distally/
    2. rounded anteroventrally/
    3. lacking anteroventral process/
    4. anteroventral margin produced into a strong, ventrally directed tooth/
    5. produced anteriorly into sharp tooth/
    6. produced anteroventrally to blunt tooth/
#38. Pereopod 3, anteroventral process of coxa <size>/
    1. absent/
    2. broad, as long as broad/
    3. short, triangular/
    4. short, twice as long as its basal width/
    5. produced and bluntly rounded/
    6. absent/
    7. less than three times its basal width/
    8. three times or greater its basal width/
#29. Pereopod 3, posteroventral margin of coxa <shape>/
    1. produced ventrally as a narrow rounded lobe/
    2. rounded/
    3. acuminate or acute/
#30. Pereopod 3, merus <length>/
    1. equal to carpus and propodus combined/
    2. shorter than basis, longer than carpus and propodus combined/
    3. longer than carpus and propodus combined/
    4. subequal to propodus/
    5. longer than propodus/
#31. Pereopod 3, carpus <shape and size>/
    1. half length of propodus/
    2. subequal to propodus/
    3. slightly shorter than propodus/
    4. longer than propodus/
#32. Pereopod 3, propodus <spination>/
    1. with 2 anterodistal spines/
    2. with anterodistal setae/
    3. with 1 large curved spine at posterodistal projection/

4. posterior margin produced, with 2–3 distal spines/
5. with 3 anterior marginal spines/
6. with 1 short distomedial (palmar) spine/

#33. Pereopod 3, palm of propodus <palm>/
1. minute/
2. not deeply recessed/
3. with 1 medial spine/
4. deeply recessed, subtriangular/

#34. Pereopod 4, coxa <shape and size>/
1. ventral margin rounded/
2. anteroventral and posteroventral margins acute/
3. anteroventral and posteroventral margins bluntly produced/
4. anteroventral margin with long blunt tooth, posteroventral margin rounded/
5. anteroventral margin produced into blunt tooth, posteroventral margin rounded/
6. anteroventral margin not strongly produced/

#35. Pereopod 4, anteroventral angle of coxa <shape>/
1. produced to form long sharp tooth three times its basal width/
2. broadly rounded/
3. produced to form sharp tooth/
4. produced to form blunt tooth/

#36. Pereopod 4, posteroventral angle of coxa <shape>/
1. produced to form blunt tooth/
2. acuminate/
3. produced to form sharp tooth/
4. rounded/

#37. Pereopod 4, merus <length>/
1. subequal to basis/
2. longer than carpus and propodus combined/
3. subequal to carpus and propodus combined/
4. subequal to propodus/
5. longer than propodus/

#38. Pereopod 5, coxa, <shape>/
1. bifid, both lobes rounded ventrally/
2. anteroventral margin slightly produced/
3. posterior margin rounded/
4. anteroventral lobe deepest/
5. anteroventral and posteroventral angles rounded/
6. deeper anteriorly, tapering posteriorly, with strong anteroventral process/
7. with a strong anteroventral process/

#39. Pereopod 5, basis <shape and size>/
1. with oval posterior lobe prolonged distally/
2. subequal to basis/
3. expanded proximally/
4. not expanded proximally/

5. subequal to merus with weak posterior lobe near base/
6. expanded proximally, length less than two times width/
7. longer than merus without posterior lobe at base/
8. longer than merus, with posterior lobe at base/

#40. Pereopod 5, merus <size and shape>/
1. longer than carpus, propodus, and dactyl combined/
2. shorter than merus of pereopod 3/
3. longer than carpus and propodus combined/
4. shorter than carpus and propodus combined/
5. equal to carpus and propodus combined/

#41. Pereopod 5, carpus <length>/
1. shorter than propodus/
2. longer than propodus/
3. subequal to propodus/

#42. Pereopod 6, coxa <shape>/
1. posterior margin rounded/
2. wider than long/
3. with a triangular tooth anteriorly/
4. with small, rounded anteroventral lobe/
5. shaped like coxa 5, but smaller/
6. ventral angles rounded/
7. ventral margin irregular/

#43. Pereopod 6, basis <shape and size>/
1. widened proximally/
2. with anterodistal setae/
3. with a posterior proximal knob/
4. longer than merus/
5. with 4 posterior spines on distal half/
6. with a proximal knob-like process anteriorly/
7. with small toothed posterior proximal expansion/
8. subequal to merus/
9. with posterodistal setae/

#44. Pereopod 7, coxa <shape>/
1. posteroventral angle produced, acute/
2. anteroventral margin produced, bluntly rounded/
3. posteroventral margin produced into blunt lobe/
4. anteroventral angle rounded/
5. rounded posteriorly/
6. similar in shape to coxa 5 and 6 but smaller/
7. posterior margins sharp/

#45. Pereopods 5 and 7, carpus <size>/
1. longer than propodus/
2. shorter than propodus/
3. subequal to propodus/

#46. Pereopod 7, basis <shape and spination>/
1. with posterodistal and anterodistal spines/

2. with 1 posterodistal spine/
3. with 4–5 anteromarginal spines/
4. with 4 posteromarginal spines/
5. with 2–3 small posteromarginal spines/
6. posterior margin with 3 strong, upturned spines on proximal half and 3 short spines distally/
7. posterodistal setae/
8. weakly expanded proximally/
9. with strong posterior spines/
10. linear/
11. linear, slightly expanded at base, with strong posterior spines/
12. sublinear/

#47. Pereopod 7, merus <length>/
1. shorter than carpus and propodus combined/
2. longer than basis/
3. longer than carpus, propodus, and dactyl combined/
4. shorter than basis/
5. subequal to carpus and propodus combined/

#48. Pereopod 7, propodus <distal spine>/
1. palm lacking medial spine/
2. produced posterodistally with 1 long curved spine/
3. produced distally with 2–3 spines/
4. with 2–3 anterior spines/
5. palm with short, strong distomedial spine/

#49. Pleon segments 1–3 <spination>/
1. without dorsal teeth/
2. each with a large dorsal tooth/

#50. Epimeral plate 1, <shape and spination>/
1. rounded ventrally/
2. ventral margin with 3–4 slender spines/
3. ventral margin with 8–10 short setae/
4. ventral margin with 3–4 setae/
5. posteroventral angle with a small, triangular tooth/
6. tapered distally/
7. posteroventrally acuminate/
8. posteroventral corner evenly rounded/
9. ventral margin with 2–3 short, curved spines/

#51. Epimeral plate 2, <shape and spination>/
1. rounded/
2. posteroventral angle with a small triangular tooth/
3. ventral margin with 3–4 slender spines/
4. with a strong posterodistal spine/
5. acuminate/
6. evenly rounded distally with 2 ventral marginal spines/
7. posterodistally produced, rounded/
8. with tooth/

9. squarish/
10. with small tooth/
11. ventral margin with 2–3 short, curved spines/

#52. Epimera 2 and 3, <setae>/
1. ventral margins with 3–4 spines/
2. ventral margins with sparse, slender setae/
3. anterior margins with a few short setae/
4. anteroventral margin without setae/
5. anteroventral margin with setae/

#53. Epimeral plate 3, posteroventral margin <shape>/
1. with a small triangular tooth/
2. rounded/
3. slightly produced, acute/
4. with a large triangular tooth/
5. acuminate/
6. with tooth/
7. squared/
8. rounded/

#54. Epimeral plate 3, ventral margin <setation>/
1. with 3–4 slender setae/
2. with 3–4 slender spines/
3. convex with 5 long setae/
4. with 3 short spines/
5. with 4 short spines/
6. with 2 strong curved spines/
7. with plumed setae and one strong spine at posteroventral angle/
8. with 2–3 short setae/
9. with plumed setae/

#55. Urosomite 1, dorsal margin <shape>/
1. posterior margin concave/
2. with a proximal saddle-shaped concavity/
3. extended posteriorly to mask part of urosomite 2–3/
4. dorsal keel with acute posterior process/
5. with small posterodorsal tooth/
6. weakly carinate without strongly projecting tooth/
7. with strong triangular tooth/
8. smoothly rounded/
9. strongly produced posteriorly to form blunt process/
10. upturned posteriorly to form a tooth/
11. low, not produced posteriorly/
12. low, weakly toothed behind/

#56. Urosomites 2 and 3, <number of dorsal spines>/
1. with paired proximal and distal dorsal spines/
2. with 1 proximal spine/
3. dorsal margins of lobes with a proximal and distal spine/
4. with 4 dorsal spines proximally/

5. with greater than 3 dorsal spines/
6. with 0–3 dorsal spines/

#57. Urosomite 2–3, dorsolateral margins <shape>/
1. without marginal or dorsal spines/
2. with two short spines/
3. with rounded lobes/
4. forming keels, running out to form acute lobes/
5. forming keels running out to form straight a strong tooth/
6. rounded/

#58. Uropod 1, <total comparative length>/
1. subequal to uropod 3/
2. shorter than uropod 3/
3. longer than uropod 3/

#59. Uropod 1, peduncle <marginal setae on peduncle>/
1. with a long, curved interramal spine/
2. with a large, curved distolateral spine/
3. with a long posterodistal spine one quarter length of peduncle/
4. dorsolateral margin with a row of strong spines and 1 interramal spine/
5. with a posterodistal spine and distal simple setae/
6. with ventral plumed setae and a row of dorsolateral spines/
7. with 3 elongate ventral setae/
8. with strong row of short spines on inner and outer dorsolateral margins/
9. with two proximomedial spines and one distal spine/
10. with several long setae on distal margin/
11. fringed with ventral setae/
12. lacking marginal setae/

#60. Uropod 1, <length of rami>/
1. inner ramus subequal to peduncle/
2. inner ramus shorter than outer ramus/
3. rami subequal/

#61. Uropod 1, peduncle <relative length>/
1. longer than rami/
2. subequal to inner ramus/
3. much shorter than outer ramus/
4. shorter than rami/
5. equal to outer ramus, longer than inner ramus/

#62. Uropod 1, rami <setation>/
1. with apical spines/
2. outer ramus with dorsolateral spines/
3. inner ramus with dorsolateral spines/
4. inner ramus with 1 apical spine/
5. outer ramus with terminal and subterminal spines/
6. both rami with dorsolateral spines and apical spines/
7. with marginal spines and long apical spines on both rami/
8. without marginal spines/
9. with long terminal setae/

#63. Uropod 2, peduncle <length and spination>/
1. with 2 distolateral spines/
2. with strong distolateral spines/
3. shorter than rami with a strong distomedial spine/
4. with 3 or 4 dorsolateral spines/
5. slightly longer than rami with 1–4 outer marginal spines/
6. equal to outer ramus in length/
7. subequal to rami/
8. less than half length of inner ramus/

#64. Uropod 2, inner ramus <relative length>/
1. longer than peduncle/
2. shorter than peduncle of uropod 3/
3. longer than outer ramus/
4. extending well beyond peduncle of uropod 3/
5. shorter than outer ramus/
6. subequal to peduncle/

#65. Uropod 2, outer ramus <compared to inner>/
1. subequal to inner ramus/
2. shorter than inner/

#66. Uropod 2, <spination>/
1. rami without apical spines/
2. rami with long apical spines/
3. spinose/
4. inner margin of inner ramus with 1 or 2 proximal spines/
5. outer margin of outer ramus with 4–5 spines/
6. rami with short apical spines/
7. peduncle and rami strongly spinose/

#67. Uropod 3, peduncle <size>/
1. subequal to outer ramus/
2. shorter than rami/
3. one fourth length of inner ramus/
4. less than one half length of rami/
5. one half length of inner ramus/

#68. Uropod 3, peduncle <spination>/
1. with 1–3 dorsolateral spines/
2. without spines/
3. with 2 distal spines/
4. with dorsal spines/
5. with a short, distal spine on dorsal margin/

#69. Uropod 3, rami <shape>/
1. lanceolate, distally upturned/
2. wide proximally, tapering to apices/
3. lanceolate/

#70. Uropod 3, <rami spination>/
1. inner ramus with 2–3 marginal spines/
2. inner ramus with 8 spines/

3. outer ramus with 6–8 spines/
4. inner ramus with 4 dorsolateral spines/
5. outer ramus with 4 dorsolateral spines/
6. inner ramus with 2–3 outer marginal spines and 1 inner marginal spine/
7. outer ramus with 2 outer and 2 inner marginal spines and accessory nail/
8. rami with marginal setae/
9. inner ramus with several marginal setae/
10. both rami strongly spinose marginally/
11. outer ramus, outer margin spinose/
12. outer margin of outer ramus with 1–3 short spines/
13. rami without spines/

#71. Uropod 3, inner ramus <relative length>/
1. shorter than outer/
2. exceeding the length of the telson/
3. twice length of telson/
4. subequal to outer ramus/
5. three times as long as peduncle/
6. twice length of peduncle/
7. longer than outer ramus/

#72. Uropod 3, <length>/
1. twice length of peduncle/
2. subequal to uropod 1/
3. rami longer than peduncle/
4. exceeding telson/
5. inner ramus greater than twice the length of peduncle/
6. longer than uropod 1 and telson/

#73. Uropod 3, outer ramus <length relative to inner ramus>/
1. subequal to inner ramus/
2. shorter than inner/
3. half length of inner ramus/
4. three-fourths length of inner ramus/
5. slightly shorter than inner/
6. two thirds length of inner ramus/

#74. Telson, <shape>/
1. triangular, acute distally/
2. broadly lanceolate, acute distally/
3. broadest medially/
4. broadest proximally/

#75. Telson, <relative length>/
1. two thirds length of uropod 3/
2. shorter than uropod 3/
3. equal to rami of uropod 3/
4. attaining middle of uropod 3/

#76. Telson, <number of marginal spines>/
1. with 2 marginal setae/
2. with several marginal spines/

3. with no lateral spines/
4. greater than 6 lateral spines/
5. with 1 lateral spine/
6. with 2–3 lateral spines/
7. with 2 mediodistal spines and 1 pair of mediolateral setules/
8. with 4–6 lateral spines/

#77. Telson, apical spines <presence or absence>/

1. absent/
2. present/

APPENDIX D

Character diagnostics of most the parsimonious tree from parsimony analysis

Tree rooted using four out-groups
Tree length = 531
Consistency index (CI) = 0.5197
Homoplasy index (HI) = 0.2150
Retention index (RI) = 0.4137
Fit = 0.4802
Character summary: 77 characters, all with equal weight and with unordered character states, nine were parsimony-uninformative; gaps were treated as “missing”; character states were optimized with Accelerated transformation (ACCTRAN)

Character diagnostics:

Character	CI	RI	RC	HI	fit
1 (head, anteroventral margin <sh)	1.000	0/0	0/0	0.000	1.000
2 (eye <shape>)	0.500	0.556	0.278	0.500	0.429
3 (maxilla 1, inner plate <shape>)	0.667	0.000	0.000	0.333	0.750
4 (maxilla 1, outer plate with <n)	0.714	0.600	0.429	0.286	0.600
5 (maxilla 1, palp <length>)	0.429	0.556	0.238	0.571	0.429
6 (maxilla 1, palp <shape>)	0.500	0.429	0.214	0.500	0.429
7 (maxilla 2, inner plate <length)	0.500	0.500	0.250	0.500	0.600
8 (maxilliped, palp segment 4 <pr)	1.000	1.000	1.000	0.000	1.000
9 (maxilliped, palp <length of pa)	0.400	0.400	0.160	0.600	0.500
10 (maxilliped, outer plate <spine)	0.636	0.000	0.000	0.364	0.429
11 (maxilliped, inner plate <spine)	0.778	0.500	0.389	0.222	0.600
12 (coxa plates 1-4 <length>)	1.000	0/0	0/0	0.000	1.000
13 (gnathopod 1, coxa, <shape>)	0.417	0.364	0.152	0.583	0.300
14 (gnathopod 1, carpus <size and)	0.500	0.500	0.250	0.500	0.600
15 (gnathopod 1, propodus <shape>)	0.545	0.545	0.298	0.455	0.375
16 (gnathopod 1, propodus < length)	0.667	0.833	0.556	0.333	0.750
17 (gnathopod 1, males (notch))	1.000	0/0	0/0	0.000	1.000
18 (gnathopod 2, coxa <shape>)	0.455	0.333	0.152	0.545	0.333
19 (gnathopod 2, merus <relative l)	0.600	0.600	0.360	0.400	0.600
20 (gnathopod 2, propodus <length)	0.250	0.250	0.062	0.750	0.500
21 (gnathopod 2, propodus <shape;)	0.444	0.500	0.222	0.556	0.375
22 (pereopods 3-7, carpus <length)	1.000	0/0	0/0	0.000	1.000
23 (pereopods 3-7, <form of chelae)	1.000	1.000	1.000	0.000	1.000
24 (pereopods 3 and 4, carpus <len)	0.400	0.500	0.200	0.600	0.500
25 (pereopods 5-7, coxae <size>)	0.500	0.333	0.167	0.500	0.600
26 (pereopod 5-7 merus <length>)	1.000	0/0	0/0	0.000	1.000
27 (pereopod 3, anteroventral marg)	0.500	0.545	0.273	0.500	0.375
28 (pereopod 3, anteroventral proc)	0.455	0.455	0.207	0.545	0.333
29 (pereopod 3, posteroventral mar)	0.400	0.400	0.160	0.600	0.500
30 (pereopod 3, merus <length>)	0.400	0.250	0.100	0.600	0.333
31 (pereopod 3, carpus <shape and)	0.429	0.333	0.143	0.571	0.429
32 (pereopod 3, propodus <spinatio)	0.500	0.500	0.250	0.500	0.600
33 (pereopod 3, palm of propodus <)	0.667	0.000	0.000	0.333	0.750
34 (pereopod 4, coxa <shape and si)	1.000	0/0	0/0	0.000	1.000
35 (pereopod 4, anteroventral angl)	0.375	0.286	0.107	0.625	0.375

36	(pereopod 4, posteroventral ang)	0.500	0.667	0.333	0.500	0.600
37	(pereopod 4, merus <length>)	0.444	0.167	0.074	0.556	0.375
38	(pereopod 5, coxa, <shape>)	0.444	0.000	0.000	0.556	0.375
39	(pereopod 5, basis <shape and s)	0.545	0.286	0.156	0.455	0.375
40	(pereopod 5, merus <size and sh)	0.500	0.000	0.000	0.500	0.500
41	(pereopod 5, carpus <length>)	0.400	0.000	0.000	0.600	0.500
42	(pereopod 6, coxa <shape>)	0.444	0.444	0.198	0.556	0.375
43	(pereopod 6, basis <shape and s)	1.000	1.000	1.000	0.000	1.000
44	(pereopod 7, coxa <shape>)	0.400	0.400	0.160	0.600	0.333
45	(pereopods 5 and 7, carpus <siz)	0.667	0.667	0.444	0.333	0.750
46	(pereopod 7, basis <shape and s)	0.500	0.500	0.250	0.500	0.500
47	(pereopod 7, merus <length>)	0.750	0.667	0.500	0.250	0.750
48	(pereopod 7, propodus <distal s)	0.750	0.000	0.000	0.250	0.750
49	(pleon segments 1-3 <spination>)	1.000	0/0	0/0	0.000	1.000
50	(epimeral plate 1, <shape and s)	0.667	0.714	0.476	0.333	0.600
51	(epimeral plate 2, <shape and s)	0.750	0.778	0.583	0.250	0.600
52	(epimera 2 and 3, <setae>)	1.000	1.000	1.000	0.000	1.000
53	(epimeral plate 3, posteroventr)	0.462	0.462	0.213	0.538	0.300
54	(epimeral plate 3, ventral marg)	0.667	0.200	0.133	0.333	0.429
55	(urosomite 1, dorsal margin <sh)	0.500	0.273	0.136	0.500	0.273
56	(urosomites 2 and 3, <number of)	0.625	0.500	0.312	0.375	0.500
57	(urosomite 2-3, dorsolateral ma)	0.571	0.400	0.229	0.429	0.500
58	(uropod 1, <total comparative l)	0.500	0.000	0.000	0.500	0.600
59	(uropod 1, peduncle <marginal s)	0.700	0.667	0.467	0.300	0.500
60	(uropod 1, <length of rami>)	0.333	0.429	0.143	0.667	0.429
61	(uropod 1, peduncle <relative l)	0.667	0.333	0.222	0.333	0.600
62	(uropod 1, rami <setation>)	0.571	0.000	0.000	0.429	0.500
63	(uropod 2, peduncle <length and)	0.455	0.333	0.152	0.545	0.333
64	(uropod 2, inner ramus <relativ)	0.455	0.250	0.114	0.545	0.333
65	(uropod 2, outer ramus <compare)	0.200	0.200	0.040	0.800	0.429
66	(uropod 2, <spination>)	1.000	1.000	1.000	0.000	1.000
67	(uropod 3, peduncle <size>)	0.500	0.429	0.214	0.500	0.429
68	(uropod 3, peduncle <spination>)	0.444	0.286	0.127	0.556	0.375
69	(uropod 3, rami <shape>)	0.500	0.500	0.250	0.500	0.600
70	(uropod 3, <rami spination>)	0.400	0.182	0.073	0.600	0.250
71	(uropod 3, inner ramus <relativ)	0.444	0.375	0.167	0.556	0.375
72	(uropod 3, <length>)	0.500	0.429	0.214	0.500	0.429
73	(uropod 3, outer ramus <length)	0.333	0.200	0.067	0.667	0.273
74	(telson, <shape>)	0.273	0.273	0.074	0.727	0.273
75	(telson, <relative length>)	0.273	0.200	0.055	0.727	0.273
76	(telson, <number of marginal sp)	0.545	0.545	0.298	0.455	0.375
77	(telson, apical spines <presenc)	0.200	0.200	0.040	0.800	0.429

APPENDIX E

Burrow characteristics of *Polycheria* sp. A from St. Joseph Bay, Florida

	Host Specimen	Width (mm)	Average	Length (mm)	W/L Ratio	Occupied
1	*Eudistoma* sp. A	1	1.55	2.1	0.47	yes
2		1.2	1.8	2.4	0.5	yes
3		0.7	1.1	1.5	0.46	no
4		2	2.4	2.8	0.71	yes
5		0.8	1.3	1.8	0.44	yes
6		1.8	2	2.2	0.81	yes
7		0.5	1.45	2.4	0.21	no
8		0.6	1.3	2	0.3	no
9		0.8	1.5	2.2	0.36	yes
10		0.8	1.4	2	0.4	yes
11		1.2	1.4	1.6	0.75	no
12		1.1	1.35	1.6	0.68	no
13	*Eudistoma* sp. B	1	1.7	2.4	0.41	yes
14	*Didemnum* sp. A	1.5	2.15	2.8	0.64	yes
15		0.8	1.6	2.4	0.33	no
16		0.5	1.45	2.4	0.21	yes
17		0.5	1.15	1.8	0.27	no
18		0.2	0.5	0.8	0.25	yes
19		0.8	1.5	2.2	0.36	yes
20		0.5	1.15	1.8	0.27	no
21		0.5	1.05	1.6	0.31	no
22		0.8	1.6	2.4	0.33	yes
23	*Eudistoma* sp. A	0.8	1.3	1.8	0.44	no
24		0.7	1.35	2	0.35	no
25		1.4	2.4	3.4	0.41	no
26		0.8	1.3	1.8	0.44	no
27	*Didemnum* sp. B	1	1.4	2.7	0.37	yes
28		0.8	1.2	1.6	0.5	yes
29		0.6	1.1	1.6	0.38	no
30		1	2.3	3.6	0.27	yes
	Sum	26.7		63.7	12.63	
	/30	N=30		N=30	N=30	
	Average	χ= .89		χ=2.1	χ=.42	

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